Development of a scale-adaptive indicator for the simulation of thermomechanically loaded SMA matrix composites

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ABSTRACT

Shape memory alloys are used with their outstanding properties. Due to the high costs, these can currently only be used in special applications. One possibility is to use them in combination with a low-cost matrix material. From a numerical point of view, the combination of arbitrary materials requires a considerable additional effort in the simulation, especially with regard to the nonlinear behaviour of SMA, and with regard to thermal and mechanical loads, the computational effort increases considerably. A multi-scale simulation offers a possibility to consider the changed material properties of the SMA. For this purpose, the macroscopic material properties are determined with an accompanying homogenization on the micro level and thus the structural behavior of the composite material is represented. The accompanying homogenization results in an exponential growth of the equations depending on the macroscopic structure discretization. In this paper, an approach is presented that takes this state of affairs into account. The accompanying homogenization is performed at each Gaussian point of the macroscale. The SMA, however, show constant material properties within a certain range, therefore the material properties of the macroscopic material parameters do not change. The indicator is formulated distortion-based and thus compared with the macroscopic distortions in the Gaussian point of the macroscale.

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