On the computation of the macroscopic tangent for multiscale volumetric homogenization problems

İ. Temizer, P. Wriggers

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Abstract

In this contribution, methods of computing the macroscopic tangent that is required inmultiscale volumetric homogenization problems are investigated. A condensationprocedure that employs the tangent information from the microscale finite element analysis is derived within a special framework where deformation controlled boundary conditions in micromechanical testing are enforced via the penalty method. The developed methodology is demonstrated by sample macroscale problems in the context of the multilevel finite element strategy. Due to the high memory allocation costs that the condensation procedure induces, a perturbation procedure is developed based on a minimal number of micromechanical tests. Results from the condensation and perturbation procedures are compared for sample infinitesimal and finite deformation inelasticity problems and the algorithmic consistency of the macroscopic tangent with the evolution of the macroscopic stress is discussed. It is shown that the ability to compute the macroscopic tangent can also be employed to construct a stress controlled micromechanical testing procedure.

The complete document can be found here.