Optimization clustering technique for PWUTFA homogenization of viscoplastic composites

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ABSTRACT

Composites materials are becoming more and more popular in many fields of engineering. A composite material is obtained from two or more constituents with significantly different physical or chemical properties.

In order to study the mechanical response of composite material, the micro-mechanical problem must be solved. The overall behavior of the Representative Volume Element (RVE) can determined by using the Finite Element Method, allowing to obtain satisfactorily accurate predictions. However, the computational effort usually associated to the RVE investigation is very large since it can require very fine discretizations and, consequently, a significantly large number of variables to introduce into the analyses. To abate such computational effort, Reduced Order Models (ROM) can be employed, since they allow to solve the micro-mechanical problem in a reasonable computing time.

Within the framework of ROM, some of them ([1, 2]) are founded on the idea that it is possible to divide the RVE into large subdomains: such subdomains are usually referred to as material clusters or material subsets. The main objective of such a domain decomposition, performed during the so-called offline stage, is to group together elements having, under any applied loading condition, the most similar values of strain. The quality of the results of ROM-based homogenization techniques based on the RVE cluster is significantly influenced by the choice of the subdivisions.

Accordingly, the aim of the present study is to propose a novel approach for the RVE clustering, relying on the analysis of the elastic or plastic strain fields obtained during the offline stage. Numerical examples will be performed in order to verify the efficiency of the proposed clustering approach. In particular, the results obtained by a homogenization technique based on the cluster subdivision will be compared with the nonlinear finite element analysis results.

REFERENCES

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