ANALYSIS OF THE DEFORMATION BEHAVIOUR OF DUCTILE MATERIALS WITH PARALLEL HOMOGENIZATION-BASED MULTISCALE STRATEGIES

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Focus Material: Metals

Focus of the Presentation: *Multi-scale data acquisition, characterization and experiments at different scales*

Abstract

The modelling of ductile heterogeneous multi-phase materials has been a topic of extensive research over recent years. An important class of computational homogenization techniques, where the influence of the underlying microstructure is explicitly accounted for in the resulting macroscopic response, is known as coupled multi-scale finite element modelling or FE2. This approach is based on the nested solution of boundary value problems of two coupled scales.

Although this modelling framework enables a more accurate description of material and structural behaviour, the significant computational requirements limit its applicability. Several strategies have been proposed to overcome this shortcoming and allow to perform realistic analyses, such as parallel computing, which exploits modern computer architectures. Multi-scale models are indeed well suited for the introduction of computational parallelism. Macroscopic domain decomposition [1] and master-slave schemes [2] have been used in this context.

In the present contribution, the deformation behaviour of ductile materials is analysed with a coupled multi-scale framework where two distinct parallelization strategies are critically assessed. The first is based on a master-slave scheme, which includes load balancing, and the second employs a non-conforming domain decomposition method at the macro-scale. The relative merits of each strategy will be highlighted.

References

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[2] Matsui, K., Terada, K. & Yuge, K. (2004). Two-scale finite element analysis of heterogeneous solids with periodic miscrostructures. Computers & Structures, 82, 593–606.