11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

MULTISCALE ANALYSIS OF DAMAGE USING DUAL AND PRIMAL DOMAIN DECOMPOSITION TECHNIQUES

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Key words: *Multiscale analysis, dual and primal domain decomposition methods, strain localization, strain softening*

A reliable and efficient multiscale framework for the simulation of fracture phenomena is regarded as a necessary tool for the design and optimization of engineering materials. In our view, the use of dual and primal domain decomposition techniques [1] seems to be an adequate choice for such a multiscale framework due to their parallel nature and flexibility to tackle different spatial domain resolutions.

In this contribution, the multiscale framework presented in [2] is reviewed and compared to its corresponding primal domain decomposition version. The multiscale strategy essentially consists in decomposing the structure into a number of non-overlapping domains and considering a refined spatial resolution where needed. In multiscale analysis of damage, the spatial refinement is performed where damage nucleation and propagation take place. The domain decomposition approach is mainly used to adaptively refine regions so that only part of the local operators need to be updated and treated in a non-linear way. Results reveal that dual and primal multiscale strategies are equivalent and suitable for the analysis of two and three-dimensional heterogeneous quasi-brittle materials. Parallel scalability in architectures with a moderate number of processors is observed when using a parallel direct solver for the system obtained through the dual or primal assembly of all domains [3]. Solution strategies for massively parallel computers, typically employed in domain decomposition approaches, need robust iterative solvers and are considered out of the scope of this contribution.

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