NUMERICAL MULTISCALE SOLUTION STRATEGY FOR FRACTURING HETEROGENEOUS MATERIALS

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Key Words: Multigrid, fracturing, heterogeneous materials, multiscale

This paper presents a numerical multiscale modelling strategy for simulating fracturing of concrete where the fine-scale heterogeneities are fully resolved. The fine-scale is here modelled using a hybrid-Trefftz stress formulation for modelling propagating cohesive cracks [1]. The very large system of algebraic equations that emerges from detailed resolution of the fine-scale structure, including cracks, requires an efficient iterative solver with a preconditioner that is appropriate for fracturing heterogeneous materials [2]. This presentation presents a two-grid strategy for construction of the preconditioner that utilizes scale transition techniques derived for computational homogenization. This represents an adaptation and extension of the work of Miehe and Bayreuther [3].

For the coarse scale, this paper investigates both classical C0-continuous displacement-based finite elements as well as C1-continuous elements. The preconditioned GMRES Krylov iterative solver utilises a dynamic convergence tolerance, whereby an accurate solution is only required when the Newton method is close to equilibrium. Furthermore, the Newton method is integrated with a local arc-length control technique and line search in order to capture the dissipative load path. In this presentation, the convergence properties and performance of the parallel implementation of the proposed solution strategy is illustrated on a numerical example, demonstrating size effect of the post peak response.

REFERENCES