Energy based global-local strategies with adaptive mesh refinement for the phase-field approach to brittle fracture

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ABSTRACT

Phase-field models describe formation of cracks within bodies as a transition zone between broken and unbroken material. The width of this smeared area is governed by an internal scale length parameter and, in order to obtain accurate physical solutions, the mesh cell size should be small enough to characterize correctly the sharp variations within the phase-field, leading to high computational costs.

This paper analyses different discretization procedures and compares their numerical performances in the solution of phase field approach to fracture problem. A predictor energetic principle is employed to determine the active regions where damage evolves and, by the usage of a global/local strategy, mesh adaptive refinement or a combination of the two techniques, smaller displacement and damage problems are solved. The computational costs of the simulations are therefore drastically reduced without lowering the accuracy of the results.

Initially, the effectiveness and accuracy of the different strategies are analysed and compared. After, the effects of the active zone on the performance and precision of the results is investigated via a parametric analysis. Two different numerical examples are presented in order to validate and show the efficiency of the proposed optimization strategies in lowering the computational costs and CPU times required to perform the numerical simulations.