Continuous model for ductile fracture using a phase-field model

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ABSTRACT

Dealing with material discontinuity due to the appearance of cracks, especially on a large deformation framework, has been a source of problems in the numerical simulations based on continuous polynomial fields in which traditional finite element solutions are based. Typical solutions resort to element erosion or remeshing techniques, that although useful in many practical simulations may be mesh dependent or too heavy in computational terms, respectively. Other continuous-discontinuous strategies can also be implemented adopting X-FEM techniques [1]. In this case, particularly when dealing with ductile material failure, appropriate algorithms have to be devised to take into account the transition from a critical damaged zone to the inclusion of a macro crack and to define its orientation and length according to energy and/or geometric criteria. Special integrations techniques must be adopted and multi-crack branching is not an easy task. A new continuous approach based on the phase-field theory and its recent developments [2] is implemented to address material ductile failure. The phase field variable and its evolution is associated to ductile damage through different material models. The implementation follows a similar approach to non-local gradient damage models where critical damage values define the cracked zones.

References