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A WEAK DISCONTINUITY MODEL FOR DUCTILE FRACTURE PREDICTION

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Abstract. The paper describes a finite element method with embedded weak discontinuity modes, to analyze ductile fracture problems.

The mechanisms of nucleation, growth and coalescence of voids, typical of ductile fracture, are taken into account by adopting a Gurson constitutive material response. The same constitutive model governs the weak discontinuity zone of the body. It is shown that the traction-separation law projected into the weak discontinuity zone, when its bandwith goes to zero, depends on the stress triaxiality ratio. This becomes one of the most relevant topics of the present model.

Three set of representative examples are presented. They provide a description of the numerical response of the model according to:

i) the capability to capture a wide range of failure modes as a function of the stress triaxiality ratio: shear band formations, mixed failure modes, etc.;

ii) evaluation of the fracture resistance curves in mode I crack propagation problems; and,

iii) simulation of crack growth problems in notched rectangular and round bars.

Furthermore, using different finite element meshes and bandwidth parameters D, we show in all the examples that mesh objectivity and constitutive model regularization are two distinguishing features of this approach.

In the present approach, we adopt a linearized kinematics. Thus, the numerically simulated test are assumed to undergo small geometry changes.