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EFFECT OF VISCOSITY ON THE ROBUSTNESS OF THE ELEMENT DELETION METHOD FOR CRACK PROPAGATION MODELLING

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The numerical simulation of crack propagation in solids is of main importance in fracture mechanics and has been extensively studied over the years. Several approaches have been developed in order to describe the evolving geometry of a crack [1–6], but despite the research efforts some challenges are still present. A commonly used technique in Finite Element codes is the element deletion method due to the simplicity of its numerical implementation and possible extension to 3D. Furthermore, it is possible to couple this method with any failure criterion or damage model without additional considerations. This advantages are extremely desirable for numerical approaches involving high computational costs, e.g. the multi-scale computational homogenization [7, 8], where the element deletion method can be used at the micro-scale to simulate the nucleation, growth and coalescence of micro-voids [9].

In this work, the effect of viscosity on the numerical response of the element deletion method is studied. The selected elastic-viscoplastic model corresponds to an extension of Perzyna's model, for large strains [10]. The onset for the initiation of crack and further propagation steps through metallic materials are driven by a damage model. Two benchmark tests are selected to evaluate the robustness of the method. The first test under analysis is the Compact Tension test [11] applied to an aluminium specimen. In this case the crack propagation is dominated by a single mode of separation (mode I). The second test corresponds to a steel plate under tension with two notches asymmetrically positioned in opposite corners of the specimen, resulting in a more complex state of stress. The effect of constitutive parameters governing the viscous part of the behavior is considered to study the reliability of the solution along with the discretization and failure criterion. The results were compared with those reported in [4], where a remeshing approach was adopted to model crack propagation.

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