New developments in the application of configurational mechanics to crack propagation

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ABSTRACT

The numerical description of discrete cracks and their propagation remains one of the main difficulties in the modeling of quasi-brittle materials such as rock or concrete. An emerging powerful approach is the use Configurational Mechanics concepts [1,2], in such a way that crack trajectory really corresponds to an structural energy minimum and is not predetermined by the initial mesh lines [3,4]. In the approach developed, discrete cracks, represented by zero-thickness interface elements [5], are reoriented on the basis of configurational or material forces, calculated in a FEM context by an integration over the elements of the Eshelby energy-momentum tensor [6]. The strategy is illustrated with some application examples for which the fracture path is known a priori, either for physical reasons or experimental results, and the initial mesh layout is chosen such that the lines zig-zag significantly with respect to it. The results show that the procedure implemented works successfully, that is, mesh lines do succeed in reorienting themselves during configurational iterations, so that the developing crack progressively matches the known physical trajectory.

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