DAMAGE AND FRACTURE EVOLUTION IN BRITTLE MATERIALS BY SHAPE OPTIMIZATION METHODS

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ABSTRACT. We present a numerical implementation of the Francfort-Marigo model of damage evolution in brittle materials. This quasi-static model is based, at each time step, on the minimization of a total energy which is the sum of an elastic energy and a Griffith-type dissipated energy. Such a minimization is carried over all geometric mixtures of the two, healthy and damaged, elastic phases, respecting an irreversibility constraint. Numerically, we consider a situation where two well-separated phases coexist, and model their interface by a level set function that is transported according to the shape derivative of the minimized total energy. In the context of interface variations and using a steepest descent algorithm, we compute local minimizers of this quasi-static damage model. We observe numerically that, when the damaged phase is very weak, our method is able to predict crack propagation, including kinking and branching.