Modeling of macro crack branching with integral-type non local damage model

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The macro crack branching in brittle materials is an unstable phenomenon which occurs when a single crack achieves a critical speed. The understanding of this phenomenon could lead to the design of energy-absorbing materials due to a correlation between the fracture toughness and the number of branches. However, the branching mechanism is only partially understood. A possible way to understand this phenomenon are numerical tools. In the literature, numerous numerical models exist to simulate the macro crack branching one of the most established approach is the cohesive element method. Nevertheless, with this method, the crack paths depend on the mesh. To avoid the issue of mesh dependence, other numerical methods can be selected, as for instance, the extended finite element method, peridynamics method, fracture phase field method, eigenerosion method, moving thick layer approach, gradient-enhanced model and integral-type nonlocal damage model.

In this work, the integral-type non local damage approach has been used to model crack branching on a PMMA plate. This method has been implemented in an open-source finite element library. A detailed analysis has been performed on the fitting of the model parameters to simulate the different experimental crack patterns for a large range of crack velocities. The aim of this work is to observe the emergence of a damage zone around the main crack, under various loading conditions. This damaged zone is experimentally observed by micro cracks and micro branches which could be the origin of the macro branch appearance.