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HIGH-FIDELITY SIMULATION OF BRITTLE FRACTURE PROBLEMS

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Abstract. The simulation of brittle fracture problems has long been deemed to be very sensitive to the selection of the mesh, namely, convergence of the crack path as the mesh is refined would often not be established. We argue that the culprit behind these observations is the low accuracy of the computed stress intensity factors, which define the evolution of the crack. With this in mind, we will present a collection of methods we introduced in the last few years in 2D and 3D whose end results are: (a) the stress intensity factors can be computed with arbitrary order of accuracy (in 2D), (b) the mesh does not need to be refined around the crack tip for accuracy (in 2D), and (c) numerical experiments show convergence of the computed crack paths. We demonstrate these methods with applications to thermally driven cracks on thin glass plates, and to the propagation of volcanic dikes out of a magma chamber, a hydraulic fracture problem.