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PHASE-FIELD MODELING OF BRITTLE FRACTURE WITH MULTI-LEVEL *HP*-FEM AND THE FINITE CELL METHOD

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The ability to accurately predict fracture in industrial applications involving complex geometries is constantly gaining importance. Phase-field modeling of fracture is a well-established framework that enables a unified description of failure processes including crack initiation, propagation, branching, merging in arbitrary geometries and an efficient finite element treatment. The discrete crack limit case is approached for a small length-scale parameter that controls the interface width between fully broken and undamaged phases of a material. From a computational standpoint, this calls for very fine meshes (at least locally) in order to accurately resolve the phase-field profile.

The conventional finite element method (FEM) considers a mesh whose boundaries have to coincide with the boundaries of the geometry under consideration. This makes the mesh generation process tedious for complex geometries. The finite cell method (FCM) [1] based on higher order finite elements is a non-geometry conforming discretization technique wherein the physical domain is embedded into a larger fictitious domain of simple geometry which can be easily discretized. The original geometry is recovered during the integration of the weak form. The multi-level *hp*-FEM refinement technique that adopts a refinement by superposition not only features *h*- and *p*-refinements but also enables a dynamically changing mesh that allows the refinement to remain local at singularities and high gradients [2].

The research presented in this work focuses on integrating a two-dimensional phase-field framework for brittle fracture with the multi-level dynamically adaptive *hp*-framework and the FCM. A refinement criterion that ensures a dynamically changing mesh which is adaptive in nature is developed. Various numerical examples are studied to illustrate the potential of the application of the uniform multi-level *hp*-refinement and the FCM in the context of phase-field models.

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