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eXtended Scaled Boundary Finite Element Method – higher order basis functions and quadtree meshes

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Conventional finite element method (FEM) with piecewise polynomials is inefficient to deal with stationary and/or moving discontinuity surface in the domain. A modification of the finite element spaces has led to robust methods such as the extended/generalized FEM (XFEM/GFEM), *hp*-clouds, etc., that offers greater flexibility in modeling discontinuities independent of the mesh, but require a priori knowledge of asymptotic fields. In this paper, we replace the asymptotic enrichments around the crack tip in the extended finite element method (XFEM) with the semi-analytical solution obtained by the scaled boundary finite element method (SBFEM). The proposed method, coined as the extended SBFEM does not require special numerical integration technique and it improves the capability of the XFEM to model cracks without a priori knowledge of the asymptotic solutions. We also discuss the extension of the method for the handling of hanging nodes in quadtree meshes and explore the possibility of employing NURBS basis functions, which can lead to a simplified design cycle.