**Adaptive Mesh Refinement for Analysis of Damage in Quasi-brittle Material Using an Improved Local Damage Model**

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**Abstract.** This paper presents an adaptive mesh refinement for analysis of damage in quasi-brittle material such as concrete or limestone. An improved local continuum damage model (*local model*), instead of non-local model, due to low computational cost. The issue of mesh-dependency being inherent to traditional local model is treated by introduction of fracture energy and element characteristic length into the damage evolution. Based on the so-called *bi-energy norm* concept, the equivalent strain can be split into tension and compression parts to better model the behavior of materials that exhibit higher compressive strength than tensile strength, like concrete and limestone. Here, the split operator is based on the Mazars model for concrete, resulting in an equivalent strain that has only one parameter for calibration (instead of four parameters as in the Mazars model), yet the accuracy is sufficient. For efficient computation, adaptive mesh refinement is conducted, i.e. the mesh is only updated (refined) in the vicinity of the damage zone. The damage parameter, which ranges from 0 to 1 corresponding to the degradation of a material point from being intact to complete failure, can be used as an indicator for mesh refinement. The refinement task is conducted via quad-tree technique, such that each quadrilateral element is divided into four new elements. The issue of hanging nodes is avoided by the employment of polygonal elements instead of the traditional four-node quadrilateral based on Lagrange shape functions. The accuracy and efficiency of the proposed model is demonstrated and analyzed via various numerical examples, in which comparison with results available from experiments and other numerical methods is studied.

**Keywords:** Improved local damage model, enhanced bi-energy norm, adaptive mesh refinement, hanging node, polygonal elements.