Two dimensional configurational-force-driven crack propagation using the discontinuous Galerkin method with rp-adaptation

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Abstract

This paper presents a quasi-static configurational force (CF) brittle fracture propagation method, [2], using the discontinuous Galerkin (dG) symmetric interior penalty (sip) method, [1].

The method is derived from the first law of thermodynamics with consideration of the Grithith criterion. The criterion is evaluated by finding the difference between the power applied to the domain and the rate of internal energy change at every point in the domain. If a point satisfies the criterion, the force vector which produces the energy dissipation determines the direction of crack growth, the configurational force (CF).

Around the crack tip the advantage of element specific degrees of freedom in dG methods enables simple p-adaptivity to determine the CF in the spatial domain. In the material domain r-adaptivity is implemented, the CF direction is used to align element edges, which are then split to propagate the crack. The stiffness matrix is updated around the crack tip, with the dG face terms between the newly cracked elements removed. Again, exploiting the element specific degrees of freedom, no adjustment to the data structure is required.

The problems are restricted to two-dimensions with linear geometric and material properties. A comparison of the CF values between analytical solutions and those calculated from surface integrals is presented.

Keywords. Crack propagation, configurational force, discontinuous Galerkin, symmetric interior penalty, rp-adaptation.

References

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