An adaptive transition approach from weak- to strong-discontinuity by cohesive-traction embedded damage-like constitutive law and finite cover method

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ABSTRACT

An adaptive transition approach is presented to simulate the development of the displacement field from weak- to strong-discontinuity with consistency of mechanical behaviour. The fracture process can be divided into two stages by the discontinuity of the displacement field around a crack tip. At the first stage of fracture process, the displacement field shows the weak-discontinuity caused by the reduction of the macroscopic material stiffness due to the evolution of micro defects. In our approach, the cohesive-traction embedded damage-like constitutive law is employed to realize the weak-discontinuity, which is capable to represent a cohesive zone model (CZM)[1] as a damage-like constitutive law. At the final stage, the displacement field develops the strong-discontinuity along with explicit crack opening resulting from the macroscopic material softening behaviour due to the coalescence of the micro defects. The finite cover method (FCM)[2] combined with CZM is adaptively applied to transit from the weak- to strong-discontinuity when the cohesive traction attains the maximum value. In addition, the FCM is also enhanced by automatic subdivision technique and mapping algorithm to simulate arbitrary propagation of a crack in inelastic material. These two stages of the fracture process are consistently connected by the unique feature of the cohesive-traction embedded damage-like constitutive law which deformation under tensile loading is consistent with the conventional CZMs. Numerical examples are presented to verify the equivalence of the proposed damage-like constitutive law as the FCM combined with the CZM and the performance of the automatic subdivision technique. After the demonstration of the FCM enhanced by the automatic subdivision technique and the mapping algorithm, we also present the capabilities of the adaptive transition approach.

REFERENCES

[1] A. Needleman, "Some issues in cohesive surface modeling", *Procedia IUTAM*, **10**, 221-246, (2014).

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