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2D cohesive fracture evolution within virtual element formulation

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Recently, the virtual element method (VEM) has attracted a lot of interest in different research fields, comprising solid and fluid mechanics problems. In particular, VEMs can be conveniently applied to the computational fracture mechanics applications. In this field, the numerical approaches proposed in literature are mainly based on the finite element method (FEM) or on modified forms of this latter (e.g. the extended FEM, the augmented FEM). The VEM formulation is characterized by the possibility to define polygonal meshes with elements characterized by any number of edges and by the flexibility in mesh generation that allow to introduce a crack just redefining the element in two different elements joined by a crack modelled with an interface element. Thus, VEMs are particularly suitable for the development of a procedure able to follow the crack growth requiring a minimal remeshing [1]. The present work proposes an algorithm of nucleation and growth for fracture evolution in 2D cohesive media. In particular, a four sides 12-node virtual element with a piece-wise linear approximation of the displacements on the edges is proposed. A numerical technique is developed in order to introduce the crack in one virtual element splitting it in two elements joined by a cohesive interface. An interface cohesive law, introducing a damage variable in mode I, in mode II and in mixed mode, and taking into account the unilateral effect due to the reclosure of the fracture in compression, is adopted [2]. The recovery of the stress via complementary energy within the single element is described. Moreover, in order to properly account the stress pattern around the crack tip, a non-local damage formulation is considered. Numerical applications are developed in order to assess the ability of the proposed procedure to satisfactorily reproduce the crack nucleation and growth observed in experimental tests.

REFERENCES

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