A multiscale cohesive-zone model accounting for interlocking and separation of damage and frictional dissipation

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Abstract

Cohesive-zone models (CZMs) are widely used to simulate the behaviour of structural interfaces in quasi-brittle materials along surfaces where formation and propagation of cracks are expected. With increasing mode II/mode I ratio an increasing amount of energy is dissipated by friction. Therefore, an accurate mechanical description should account for the separate contribution to dissipation provided by fracture and friction and, in presence of rough interfaces, for the interlocking effect created by the geometry of the fracture surface. In this paper, a cohesive-zone model based on a recently proposed multiscale formulation is presented. The main idea, initially developed for 2D models in [1, 2] is to model the asperities of the interface in the form of a periodic arrangement of distinct inclined planes, denominated Representative Interface Area (RIA), the interaction within each of these surfaces being governed by the interface formulation proposed in [3]. Specific features of the model are the following: 1) each microsurface is assumed to be decomposed into an undamaged and a fully damaged part; 2) the evolution of damage is assumed to depend on the elastic energy in the undamaged part; 3) it is assumed that friction occurs only on the damaged part and is governed by a Coulomb law. The validation of the model against experimental results presented in the literature and the extension of the model to 3D problems are discussed, along with current limitations and how to address them in future work.

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