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# A STUDY OF FRICTION IN DYNAMIC FRACTURE ALONG BIMATERIAL INTERFACES

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Intersonic debonding, for which the speed of the debonding front exceeds the shear wave speed of the more compliant material, has received limited attention over the past decade. In particular, the case of bimaterial problems characterized by high material mismatch shows that contact plays a key role in the failure process. Rosakis *et al.* [1, 2] performed different experiments of dynamic debonding along planar interfaces between a quasi-rigid medium made of Steel or Aluminum, and a compliant medium, PMMA or Homalite. By recording the fringe patterns in the vicinity of the propagating debonding front, they provided a better description of the subsonic/intersonic transition and the behavior of contact behind the crack tip.

We investigate numerically the dynamic in-plane debonding along bimaterial planar interfaces using a spectral formulation of the elastodynamic boundary integral equations. This boundary integral method, developed by Geubelle and Rice [3] and extended to bimaterial problems by Breitenfeld and Geubelle [4, 5], allows for the very efficient modeling of dynamic debonding using a discretization limited to the interface. It provides very fine level of refinement, unattainable with more conventional methods such as the finite element and finite difference schemes. The focus of this study is put on the role of friction along bimaterial interfaces in the transition from subsonic to intersonic regimes of propagation. The failure process is described by a rate-independent cohesive model that couples normal and shear failure modes, while friction along the interface is modeled using a regularized Coulomb friction law.

We first study a failure event along an Aluminum-Homalite interface through space-time diagrams, the evolution of damage parameters at discrete positions in the path of the crack, energetic arguments, and the evolution of the speed of the leading and trailing edges of the cohesive and contact zones. Under shear loading, two distinct behaviors are observed as function of the direction of propagation of the crack, i.e., in the same or the opposite direction of the shear displacements of the more compliant material. When the crack propagates in the same direction, the subsonic/transonic transition is sharp and the contact area appears directly after the cohesive zone. The oncoming crack propagation shows, however, a smooth subsonic/intersonic transition and a contact zone which detaches from the crack tip. These distinct behaviors of contact along bimaterial interface are very similar to the experimental observations made by Samudrala and Rosakis [2].

We also show that if the contact behavior is entirely described by the more compliant material in the Aluminum-Homalite problem, a mixed behavior (governed by the top and bottom materials) is observed when the material mismatch is reduced. Finally, we propose some general criteria describing the role of contact in dynamic debondings with the particular interest of linking the bimaterial problem to the homogeneous configuration.

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