ON THE SUPERSHEAR TRANSITION IN HETEROGENEOUS MEDIA

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During an earthquake, frictional rupture fronts mainly propagate at subshear speed along tectonic faults. However, evidences of supershear propagation have been reported in several occasions. Contrarily to subshear, supershear rupture results in high stresses and particles velocities far away from the interface.

Earthquakes are generally represented as mode II fracture. If the in plane shear load excess a critical value, a crack propagating initially at subshear velocity will transition to intersonic one through the Burrdige-Andrews mechanism. This transition happens at a defined crack size for homogeneous problem. However, realistic interfaces such as geological faults involve heterogeneities, which affect this mechanism. Both in and out plane heterogeneities can facilitate this transition via the emission and reflection of elastic waves. Using numerical methods, it has been shown how the presence of in plane successive weak and strong stripes eases the supershear transition. Front interaction with heterogeneities matters if their size is comparable to the process zone size, in which damage is localized ahead of the crack tip.

In this study, we extend these earlier works to the general case of a dynamic crack propagating along a 2D plane, with various patterns of heterogeneities. Using an elastodynamic boundary integral formulation coupled with a cohesive zone model, we systematically study the interaction of the crack front with the microstructure. Occurrence of supershear transition is extensively investigated for both organized and randomized heterogeneous pattern.