Comparison of interfacial and bulk damage models for dynamic brittle fracture

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Quasi-brittle materials are rate-dependent, meaning that the failure criterion envelope and failure patterns depend on the rate at which the loads are applied. Bulk and interfacial models are two of the main approaches that degradation is modelled in quasi-brittle materials. While the enforcement of specific interface constitutive equations (contact, friction, *etc*.) and loading (hydraulic loading) on crack surfaces is simpler than incorporating such effects with a bulk representation, accurate tracking of crack surfaces is main drawback of these models. We will present an interfacial damage model and a bulk model formulated based on Allix's time-delay evolution model to compare the behavior of these models for problems that initially lack stress concentration points and singularities such as crack tips. Both models are characterized by fracture strength and time scales with the latter dictating a (maximum) rate at which damage can accumulate.

Due to the lack of significant energy dissipation mechanisms in quasi-brittle materials, *e.g.* in comparison to plasticity for ductile materials, their response is highly dependent on microstructural defects. In the present work, we use Voronoi tessellation-based statistical volume elements (SVEs) to characterize a scalar fracture strength field at the mesoscale. The purpose of using SVEs, as opposed to more commonly used representative volume elements, is to maintain 1) material inhomogeneity, 2) randomness in macroscopic fracture parameters such as ultimate load and fracture energy. We will focus on aspect 1) in that by using different sizes of SVEs, hence the resolution of realized random fields, we study how fracture patterns are affected for both interfacial and bulk damage formulations. The comparisons are performed for fragmentation simulations under uniform stress field to better demonstrate the effect of material randomness and underlying SVE sizes.