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INTERFACIAL DELAYED-DAMAGE MODEL FOR DYNAMIC FRACTURE AND FRAGMENTATION

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We describe an interfacial damage model for rate-dependent fracture processes and its application to fragmentation problems. This sharp-interface model is distinct from bulk-damage representations and is an alternative to cohesive models with traction-separation relations. We use a space-time damage field, D, to describe intermediate conditions between the intact and fully debonded states on fracture surfaces. A delayed-damage relation [1] governs the evolution of D and includes a relaxation time scale that can capture rate-dependent fracture response. We use D to interpolate between Riemann solutions for intact and fully debonded interfaces and weakly enforce the interpolated solutions in a spacetime discontinuous Galerkin method. This preserves the characteristic structure of the hyperbolic elastodynamic system and handles crack closure, with distinct response for stick and slip conditions [2]. Our model suffers no artificial compliance in the undamaged state at any level of grid refinement and avoids the non-smooth response that might complicate numerical implementations of extrinsic cohesive models. We discuss parameter selection for realistic fracture response and present applications to fragmentation/spalling.

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