Nonlinear Fracture Dynamics: Modeling, Analysis, Approximation, and Applications

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We present our recent results for the approximation of dynamic fracture using a first-order formulation for velocity and stress with discontinuous approximations and conforming continuous approximations for the phase-field.
We recall our convergence results in case of small strain for viscoelastic materials and we show that this remains stable also in the limit of very small viscosity. Combining stability estimates with explicit error bounds for the consistency error shows the existence of a solution of the continuous problem.
Then we present first results for the extension to the approximation in space and time of finite strain models with and without phase field. The finite element approximations are compared with peridynamic simulations, where we compare the elastic wave propagation characteristics of bond-based, ordinary state-based, continuum-kinematics-based peridynamics and a local continuum consistent correspondence formulation.