

Viscous and rate-independent damage systems in nonsmooth domains

Dorothee Knees, University of Kassel

The aim of the lecture is to model damage evolution in elastic bodies as a rate-independent process. A meanwhile well established framework to describe rate-independent processes is the global energetic formulation developed by Mielke and Theil. There, the evolution is characterized via a global stability criterion and an energy balance, which must be satisfied during the whole evolution. The central quantities are a stored energy functional and a dissipation functional, which is assumed to be positively homogeneous of degree one (and thus inducing a rate-independent model). Since in many damage models the energy functional is not simultaneously convex in the damage variable and the displacements, one typically has to deal with solutions being discontinuous in time. The global energetic formulation is weak enough to allow for such solutions. However, due to the global stability criterion, the prediction of the discontinuities in general is not satisfactory: global energetic solutions may develop jumps although a local force balance criterion would predict a slow evolution or even no motion at all.

The purpose of the lecture is to discuss a vanishing viscosity approach as an alternative approach for the derivation of a local rate-independent damage model. The starting point is a nonlinear evolution inclusion for the damage variable, which is regularized with a viscosity term. The aim is to study the limit as the viscosity tends to zero. Since the dissipation potential related to damage models is unbounded, one of the challenges is to derive suitable bounds for the thermodynamically conjugated forces (i.e. the derivative of the energy with respect to the damage variable).

This is joint work with R. Rossi and C. Zanini.