Discussion of different time-discretization schemes for rate-independent damage models

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It is well known that rate-independent systems involving nonconvex stored energy functionals in general do not allow for time-continuous solutions even if the given data is smooth in time. Several solution concepts are proposed to deal with these discontinuities, among them the meanwhile classical global energetic approach and the more recent vanishing viscosity approach. Both approaches generate solutions with a well characterized jump behavior. However, the solution concepts are not equivalent. In this context, numerical discretization schemes are needed that efficiently and reliably approximate directly that type of solution that one is interested in. For instance, in the vanishing viscosity context it is reasonable to couple the viscosity parameter with the time-step size. However, the numerical examples from [1] show that even knowing the exact solution it is extremely difficult to choose viscosity and time-discretization parameters in such a way that the correct jump behavior is visible already for rather coarse discretizations. The aim of this lecture is to discuss different time-discretization schemes, to study their convergence and to characterize as detailed as possible the limit curves as the discretization parameters tend to zero. The main focus will lie on alternate minimization schemes that are quite popular in the context of damage models. Switching to a time-reparametrized picture, the behavior at jump points can be made visible and similarities and differences to other approaches will be discussed. The part on alternate minimization schemes is joint work with M. Negri, Pavia, [2].

References

[1] D. Knees, and A. Schröder, Computational aspects of quasi-static crack propagation, *DCDS-S*, **6(1)** (2013), 63–99.

[2] D. Knees, and M. Negri, Convergence of alternate minimization schemes for phase field fracture and damage, *CVGMT-Preprint*, (2015).