Arclength methods and dissipative processes – Analysis and numerical experiments

The talk is concerned with rate-independent dissipative processes and their approximations by means of balanced-viscosity solutions.

The first part deals with dissipation (pseudo-)potentials that depend not only on the rate but also on the state of the solution. An approximation scheme whose convergence proves the existence of balanced viscosity solutions is presented. One possible application is given by non-associative models in plasticity frequently employed in soil-mechanics. A variational structure thereof can be recovered based on an idea of Laborde, resulting in a state-dependent dissipation [1].

Within the second part of the talk, algorithms for approximating balanced-viscosity solutions by means of arclength-methods are discussed. The focus is on the modeling of brittle fracture, cf. [2]. It is shown that balanced-viscosity solutions indeed capture the underlying physics well.

[1] J.-F. Babadjian, G. Francfort, M.G. Mora. Quasi-static Evolution in Nonassociative Plasticity: The cap Model. SIAM J. Math. Anal., vol. 44, pp. 245-292, 2012, https://doi.org/10.1137/110823511.

[2] F. Rörentrop, S. Boddin, D. Knees, J. Mosler. A time-adaptive finite element phase-field model suitable for rate-independent fracture mechanics. CMAME, vol. 431, 117240, 2024, https://doi.org/10.1016/j.cma.2024.117240.