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Boundary Value Problems with Strain Softening Materials: Ways to Ensure Physically Sound Results

A.V. Shutov1,2

1Lavrentyev Institute of hydrodynamics, Novosibirsk, pr. Lavrentyeva 15, 630090, Russia.
2Novosibirsk State University, Novosibirsk, ul. Pirogova 1, 630090, Russia.

Local models of inelasticity formulated in the framework of classical solid mechanics are widely used for the analysis of engineering applications. In particular, geometrically nonlinear ductile damage models accounting for nonlinear phenomena, like isotropic, kinematic, and distortional hardening, are useful for the optimization of metal forming operations as well as crash-test simulations. Even more, models of combined creep-fatigue interaction allow one to estimate the lifetime of critical industrial components and to assess possible failure mechanisms. Unfortunately, finite-element computations for models with strain softening materials show pathological mesh dependence of the simulation results. The talk is devoted to several approaches which allow us to obtain well-defined solution procedures for such applications, even when dealing with strain localization on the macro scale. The discussed approaches include regularization by viscosity, implementation of non-local ductile damage models, and the use of advanced mesh-free discretization methods. The impact of the regularization methods on the strain localization is investigated. It is shown that numerous length scales may act as localization limiters thus bringing us closer to a physically sound solution.