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On the gradient regularization of the Kachanov-Rabotnov type continuum damage model

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ABSTRACT

Continuum damage mechanics has developed into an important and active field of continuum mechanics. Progressing degradation of elastic properties will eventually lead to strain softening behaviour, which can result to ill-posedness of the underlying partial differential equation system. In numerical solution the ill-posedness caused by strain softening produces severe mesh size dependency. Several remedies have been proposed to alleviate or remove this deficiency: non-local integral constitutive models, adding spatial gradients, rate-dependency, etc.

In this talk behaviour of the classic Kachanov-Rabotnov as well as its gradient enhanced type continuum damage constitutive model are studied. Dispersion analysis as well as numerical finite element and finite difference study of one-dimensional dynamic problem have been performed. Even though the classic non-gradient Kachanov-Rabotnov damage model involves rate-dependency, it does not completely resolve the pathological mesh sensitivity from the numerical solution. It is shown that to obtain a mesh independent numerical solution, the loading rate should be below a certain threshold. This is in contrast to numerical solutions in viscoplasticity.

Thermodynamic formulation of the gradient damage model is discussed.

Keywords: continuum damage mechanics, gradient enhancement, strain localization, length scale