Einladung zum Seminarvortrag im Aachener Mechanik & Statik Kolloquium

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Fakultät für Bauingenieurwesen 2130

Mies-van-der-Rohe-Straße 1 | 2. OG | Raum BS 218

RWTH AACHEN UNIVERSITY

„A novel approach to gradient-enhanced brittle damage modeling"

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The modeling of damage is associated with severe numerical problems when mechanical stiffness is lost after some threshold value in terms of external loads is exceeded. From a mathematical perspective, the problem formulation becomes ill-posed with the onset of damage. Hence, appropriate regularization is unavoidable of which different approaches exist. Particularly, brittle damage evolution evolves locally both in time and space, demanding sophisticated regularization schemes and evoking numerical challenges.

In recent works, we presented a novel approach to brittle damage modeling that is based on the well-known strategy of gradient enhancement which, however, is not employed on an "auxiliary" field function but on the damage function itself. Variational modeling schemes yield a partial differential inequality (PDI) for the damage function. Although the inequality might seem more complex than, e.g. micromorphic approaches, several advantages result from the gradient penalization of the damage function.

The talk starts with a brief introduction to variational modeling and its relation to thermodynamics. After presenting the model derivation, we discuss the use of effective geometric multigrid schemes which have turned out being beneficial for many problems that arise from mechanical investigations. We apply an adaptive finite element treatment to accurately resolve the localization when a gradient-enhanced regularization is employed. We propose further a novel discretization of the Laplace term which allows for a fast solution of the PDI. Several numerical examples reveal extraordinary convergence reducing any numerical noise: although the localization is extreme, mesh-independent results are obtained thanks to the spatial adaptivity and allow for a detailed investigation of the influence of the regularization parameter.

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