Seminar

10. Februar 2010 15:30h HS 44-465

Technische Universität Kaiserslautern

zu folgendem Vortrag wird herzlich eingeladen:

On the Numerical Modeling of Solids at Failure

Christian Linder

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For the development of new materials the influence of possible defect mechanisms must be accounted for to better predict properties like durability or strength. It is the goal of this presentation to introduce a particular numerical method which is capable of accounting for defects at the macroscopic level for a wide class of material models.

Failure in solids is characterized by the appearance of localized zones along which the fracture process takes place. When considering the macroscale as the scale of interest in this work, such zones may represent cracks or shear bands along which strong discontinuities in the form of jumps of the primary variables like the displacement field in a purely mechanical based material appear. It is of particular importance to realize the challenge one faces when it comes to the constitutive modeling as well as the numerical account of such zones within numerical methods like the finite element method. One distinguishes two basic approaches depending on the resolution of these localized zones which can either be accounted for in a smeared way or by a discrete modeling. The former approach accounts for the failure through a gradual growth of microcracks and microvoids resulting through homogenization techniques in constitutive damage type material models which are capable of representing softening mechanisms characteristic for solids at failure. When the localized zone is discretely resolved one distinguishes between formulations where cohesive zones are added along the element boundaries and formulations, where the localized zones are allowed to propagate through the individual finite elements. In the latter case one distinguishes two further types of methods based on the storage of the additional degrees of freedom needed for the description of the strong discontinuity being either locally on the element level or globally at the finite element nodes.

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The approach where the localized zones of interest for the description of the failure process are allowed to go through the individual finite elements with a storage locally at the element level, often denoted as the strong discontinuity approach, is the framework of interest in this presentation. It will be shown how the so far mostly for the quasi-static case of purely mechanical based materials employed method can be extended to account for dynamic fracture by incorporating the fully transient case into the formulation with a resulting application in the crack branching simulation of brittle materials as well as how fracture in electromechanical coupled materials like piezoelectric ceramics can be incorporated by the introduction of jumps in the electric potential along the strong discontinuity in addition to the jumps in the displacement field for purely mechanical based material models. Several examples will outline the performance of the proposed formulation.

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