TECHNISCHE UNIVERSITÄT
CHEMNITZ

Energy-momentum schemes for fracture in composites

Institut für Mechanik und Thermodynamik

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Description:

The main scope of this work is the design and implementation of an energy-momentum-conserving time stepping scheme (enhanced Galerkin method) for the simulation of the fracture of unidirectional fibre-reinforced composites under dynamic loads. In this work, the phase field approach is applied for predicting the crack propagation. More precisely, the work consists in the implementation of the model described by Schlüter et al. (2014) of the phase field in the context of fracture mechanics and dynamic cases, and its subsequent extension for the simulation of anisotropic materials, such as fibre-reinforced composites. The extension to anisotropy should be performed according to the approach proposed by Zhang et al. (2019), which introduced a specific scalar parameter for penalising the damage evolution along the fibre direction, i.e. the strongest failure direction for unidirectional composites.

Work programme:

Introduction to the phase field method in the context of fracture mechanics and dynamics by searching and reviewing scientific works dealing with these topics. Within this framework, a brief summary on the different methods for introducing the irreversibility of the crack growth is welcome. 2. Implementation of a two-field (displacement and phase field) finite element formulation according to the work of Schlüter et al. (2014) and Zhang et al. (2019) in consideration of the anisotropy. 3. Implementation of an enhanced Galerkin time stepping scheme for the consistency of the total energy as well as linear and angular momentum. 4. The implemented material model and time stepping scheme are applied for simulating few benchmark examples taken from other works and finally validated by comparison with simulations and experiments taken from the same above-mentioned works (e.g. Carlsson and Isaksson, 2018). Further developments in the work includes the comparison of simulation results for different fibre orientations, particularly with regard to the change in the path of the growing crack.

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