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Kolloquium für Mechanik

Referee:	**Dr. Marek Fassin** Institute of Applied Mechanics, RWTH Aachen University, Germany
Date:	Thursday, January 9, 2020
Time:	15:45 h
Location:	Building 10.81, Emil Mosonyi-Hörsaal (HS 62, R 153)
Title:	**Modeling of gradient-extended anisotropic damage using a second order damage tensor**

Abstract

In the presented model anisotropic damage is modeled via a damage tensor of second order. The model fulfills the damage growth criterion [1], recently published by the authors, which ensures that the stiffness of a material without healing effects decreases in any direction during a damage process (or remains at least unchanged). Noteworthy, several anisotropic damage models from the literature violate this criterion which means that artificial stiffening effects can occur. It is shown how tension compression asymmetry, which is observed for many (quasi-) brittle materials, can be incorporated into the model. Using the spectral decomposition of the strain tensor the elastic strain energy can be written in terms of a tension related part which is damaged (completely) and a compression related part which is partially damaged or not at all. Mesh-objectivity is obtained by using a micromorphic approach in the spirit of Forest [2]. This approach represents a unifying procedure for the incorporation of gradient effects and introduces an internal length into the material model. In the micromorphic approach additional balance equations are introduced which involve additionally introduced generalized stresses. Although using a damage tensor of second order, the proposed formulation introduces only one scalar additional balance equation and therefore only one additional scalar micromorphic (nonlocal) variable, which is very efficient.
In order to illustrate the behaviour of the anisotropic damage model, studies at integration point level are shown first. Afterwards, several structural examples are presented which show the robustness of the developed FE formulation. Furthermore, mesh convergence in terms of the global force-displacement curves and the local fields is proven. In addition, the broad applicability of the model appears, which is able to represent localized damage states (fracture) as well as diffuse (distributed) damage states.

[1] Wulfinghoff, S., Fassin, M. and Reese, S.: A Damage Growth Criterion for Anisotropic Damage Models Motivated from Micromechanics. International Journal of Solids and Structures (2017).
[2] Forest, S.: Micromorphic approach for gradient elasticity, viscoplasticity, and damage. Journal of Engineering Mechanics, 135(3), 117–131 (2009).

Alle Interessenten sind herzlich eingeladen.
Prof. Dr.-Ing. Thomas Böhlke