## Application-oriented failure modeling and -characterization for polymers in automotive pedestrian protection

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## ABSTRACT

In the development process of automotive pedestrian protection for upper- and lower leg impact, the failure of polymer components plays an important role. To influence impact kinematics, fractures can either be desired or undesired. Simulation based design is a challenge for material modeling and hence characterization, particularly for failure of polymer components. [1][2]

An application-oriented concept for failure modeling in FEM simulations of polymer components in pedestrian protection is presented. Failure models are evaluated and selected by referring to component tests, scanning-electron microscopy (SEM) of failure areas and simulative analysis of continuum mechanical parameters [3]. The approach of capturing the material's behavior and the thereafter modeling including parametrization is presented as well.

In general, used flow- or failure models often exhibit a low level of complexity across the industry. Through a low number of parameters, the effort for characterization, parametrization and validation is significantly lower than that of more advanced models. However, component failure can only be accurately predicted by using complex failure models. A consequence of using simple failure models is e.g. the usual design of car components toward failure. [1][2]

In the proposed paper, the examination of the boundary conditions for failure in pedestrian protection polymer parts is described. SEM results and simulation outputs are presented to evaluate appropriate failure models [3]. Here, the stress state is considered as well as the strain rate. The material characterization for a polymer blend (PC-PET) in the highly dynamic domain is done by an innovative pendulum test. The parametrization is performed by an optimization in a reverse-engineering process. The model validation is done with more complex test samples by pendulum testing. [4][5][6]

The quality of CAE-driven development is heavily dependent on feasible and realistic computation results [2]. A good correlation of simulation and vehicle testing is therefore mandatory. The results of the process presented demonstrate a promising quality, while also creating a compromise between modeling precision and -effort. The short way from material to ready-to-use data through the fast parametrization process is a significant contribution for prototype-free development [2].

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