A gradient enhanced continuum approach towards shear cutting of carbon fiber reinforced plastics

L. Poggenpohl*, T. Brepols† and S. Reese†

* Institute of Applied Mechanics, RWTH Aachen University, Mies-van-der-Rohe-Str. 1, 52074 Germany, e-mail: Lukas.Poggenpohl@ifam.rwth-aachen.de

† Institute of Applied Mechanics, RWTH Aachen University, Mies-van-der-Rohe-Str. 1, 52074 Germany

ABSTRACT

A geometrically nonlinear approach towards shear cutting of carbon fiber reinforced plastics (CFRP) is developed. The material model aims at simulating the initiation and evolution of damage through the cutting process. In order to simulate crack propagation using a damage model, a gradient enhanced formulation of damage is implemented [1].
Experimental tests on tensile specimens were carried out as well as shear and cutting experiments. The tensile experiments suggest a brittle damaging behavior which is introduced in the material model. Cutting experiments suggest a distinction between matrix and fiber damage which is implemented in the material model as well. The distinction between fiber and matrix damage is implemented in terms of a two surface approach.
Material parameters are fitted using experimental results and an estimation of the quality of the fit is given.
Goal of the development of this new material model is to gain more insight into the material response of CFRP during shear cutting. While the material response on shear cutting of different metals is well known, there exists little to none knowledge of the material behavior of CFRP. This lack of knowledge prohibits the use of blanking in mass manufacturing of CFRP as it would be useful in car manufacturing. Therefore the gained knowledge about the cutting behavior is considered a crucial part of paving the way for CFRP into mass production [2].

REFERENCES

[1] Forest, Samuel *Micromorphic approach for gradient elasticity, viscoplasticity, and damage*. Journal of Engineering Mechanics, (2009), Vol. 135: 117-131.

[2] Poggenpohl, L., S. Wulfinghoff, and S. Reese.*A New Approach in Material Modeling Towards Shear Cutting of Carbon Fiber Reinforced Plastics*. TECHNISCHE MECHANIK (2018) Vol. 38.1: 91-96.