An energy based peridynamic state-based failure criterion

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The simulation of the structural behavior and particularly damage response is a key instrument for the development of lightweight structures as required in aerospace engineering or wind rotor blade development. The prediction of damage initiation and propagation in structural elements is a challenging task, even for state-of-the-art numerical procedures, such as the finite element method.

The peridynamic theory presents a promising approach for these requirements. It is a non-local theory which takes long-range forces between material points into account. Utilizing the state-based formulation arbitrary materials can be modeled and analyzed [3].

Proper failure criteria are needed for this formulation. The majority of publications use the so-called critical stretch model [2]. Therein, a “bond” between two points breaks when its stretch exceeds a critical value. However, this model reaches its limits when convergence is considered [1].

Therefore, in this paper a mode-dependent energy based failure criterion has been developed based on the work of Foster et. al [4]. The criterion has been implemented in the peridynamic code Peridigm.

In the scope of this publication, the fundamental theory of the failure criterion as well as the implementation in a massively parallel peridynamics code are explained. Based on these implementations, studies regarding the effect of probabilistic material properties to the crack initiation position are shown.

References