COMBINED EXPERIMENTAL AND NUMERICAL SIMULATION OF ABRASIVE WEAR AND ITS APPLICATION TO A TILLAGE MACHINE COMPONENT

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ABSTRACT
Abrasive wear of key components is a critical process limiting the lifetime of machinery for mining or farming. Technologies such as laser surface cladding have been developed to increase service life. However, materials and process parameters are mostly based on empirical data since the underlying wear mechanisms in the field are not well known.

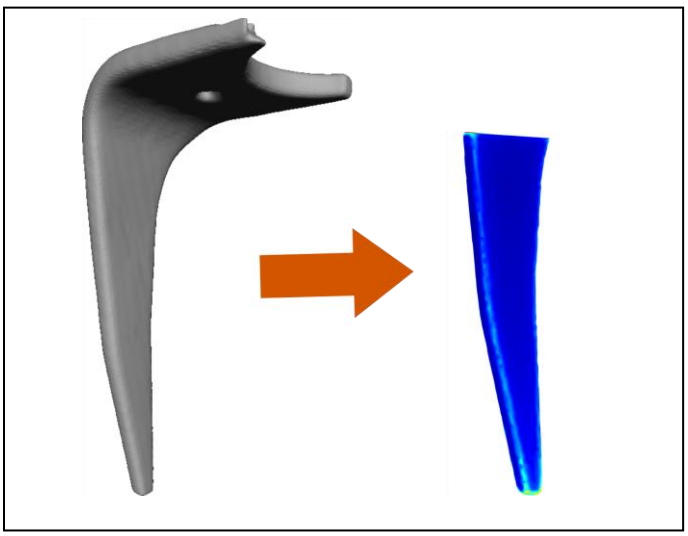

Fig. 1 Initial component geometry and simulated friction power density

In order to assess and predict the effects of abrasive wear on typical tillage machine components, the authors developed a combined experimental and numerical simulation procedure based on a time- and space-resolved version of the Archard wear equation [1, 2]. In our approach, a 3D laser scan of the real machine component is incorporated into a finite element model (FEM), and the abrasive flow – in this case, the soil moving around the component – is modelled as a Bingham fluid [3], resulting in a locally resolved friction power density (see Fig. 1). In an iterative computation, the component geometry is gradually altered based on the local wear rate as obtained from the flow simulation. Thus, the wear on the machine component can be predicted as a function of the soil parameters and the driving distance.

The experimental part consists of a laboratory-scale abrasion test (ASTM G65) and a subsequent 3D profilometric scan of the worn surface. In addition, the test is simulated numerically using the boundary element (BEM) code developed at AC²T, thus providing a validation and calibration of the employed wear model.

The applicability of the aforementioned procedure is demonstrated on a tooth of a circular harrow. The simulated worn geometry shows good agreement to the real geometry of a tooth used in a tillage field test.

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