Modelling of ductile fracture in Chip Formation Process using the Stabilized Optimal Transportation Meshfree Method

D. Huang*, C. Weißenfels and P. Wriggers

* Institute of Continuum Mechanics, Leibniz Universität Hannover
Appelstr. 11, 30167 Hannover, Germany
e-mail: huang@ikm.uni-hannover.de

ABSTRACT

In metal cutting processes, ductile fracture is the basic behaviour for chip formation. The ductile fracture is mainly induced by the localized damage under shear dominated plastic deformation with high strain and high strain rate. To accurately simulate the chip formation, the proper constitutive model and the fracture resolution method have to been developed.

The present work deals with the prediction of ductile fracture due to the shear and compression dominated large plastic deformation with localized ductile damage by use of a recently developed meshfree approximation scheme, the Optimal Transportation Meshfree (OTM) method. The finite plasticity model and the ductile damage model are applied to describe material behavior. The material-point erosion approach, originally derived from the eigenfracture scheme, is applied to simulate the ductile fracture as well in the present work. A nodal splitting algorithm is developed to resolve the crack propagation and fracture in the cutting zone.

The ductile fracture model and nodal split algorithm are validated by benchmark test simulations. The chip formation process is simulated and compared with the experimental results.