3D modeling and scaling effects in drilling

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Abstract

In this paper, a three dimensional model for the drilling process is developed using the finite element method. The drills are specified in the model by the CAD-data. A constitutive material law based on Split-Hopkinson-Bar tests is applied to describe the material behaviour of the workpiece during the cutting process. Once the tool and process parameters (e.g. drill diameter, cutting speed, feed rate) are given, the process reactions like cutting torque, feed force, cutting edge temperature can be predicted by this educed FEM-model. To validate the drilling process model, experiments are performed for steel AISI 1045 using different drills of diameters ranging from 1 to 10 mm. A non-linear scaling effect on the related feed forces is observed in tests within the mentioned drill diameter interval. The results of the obtained scaling effect simulation confirm the effectiveness of the developed numerical model.