3D Finite Element Modelling of Burr Formation in Grinding

J.C. Aurich[1], H. Sudermann[1], H. Bil[1]
[1]Kaiserslautern University of Technology, Institute of Manufacturing Engineering and Production Management, Kaiserslautern, Germany
aurich@cck.uni-kl.de

Abstract

Increasing industrial requirements on the precision of edge geometry lead to the investigation of burr formation, particularly in finishing operations such as grinding. The objective of this research is to understand the mechanism of burr formation in grinding. In recent years, finite element modelling has become the main tool for the analysis of machining operations with defined cutting edges. However, modelling of machining with undefined cutting edges, such as grinding, is still in an ongoing development stage. Multiple superpositioned single grit cutting, which leads to microscopic material deformation and removal, is difficult to model. In this scope, a 3D thermo-mechanically coupled finite element model of the grinding process has been developed and used to help in understanding the burr formation mechanism in grinding at the exit edge. Geometrically, the finite element model is composed of a workpiece in linear motion at the forward speed and a grinding wheel rotating at the cutting speed of the process. The workpiece is discritized as thermo-viscoplastic, whereas the grinding wheel is assumed to be rigid. Contact between the workpiece and grinding wheel is permanently updated and governed by constant shear friction model. Continuous adaptive remeshing has been utilized to recover any excessive deformation occurring at the elements. Presented paper gives detailed information on the developed finite element model and describes an innovative method of material removal to be used in the grinding simulations. Based on the observations from the simulations, guidelines for further improvement on the finite element modelling of grinding process are proposed.