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Analysis of the Cutting Tool Vibration while Milling with Changing Engagement Conditions for the Verification of Simulation Systems

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Abstract

In recent years many efforts have been made in the prediction and understanding of process stability in milling. Many models have been developed, which are capable of calculating stability boundaries or even the trajectories of the vibrating tool for stationary, non-changing engagement conditions. In the milling of free-formed surfaces the chip forms change continuously. In order to predict the process behavior of the general milling process, a simulation system has to focus on the calculation of the tool trajectory between different orbits after changing the parameters of the system. Therefore, an experimental analysis of tool vibrations for instationary milling processes is presented, which is used to determine the demands on a simulation system.
Besides the vibration patterns, which occur after a change of the engagement condition, the structure of the machined surface is examined in order to analyze the surface fault resulting from the change of the tool vibration type. This is carried out at different rotation speeds and changeovers of the depth of cut. For this purpose the process parameters are chosen in such a way that various types of bifurcations can be viewed and analyzed.
Furthermore, the experimental setup, which is used to record the tool virations along intationary cutting conditions, is presented. For the application of the results as a verification of simulation systems it is considered that most simulations neglect the contact of the cutting edges with the ground of the machined groove, which has a great influence on the tool vibration patterns.