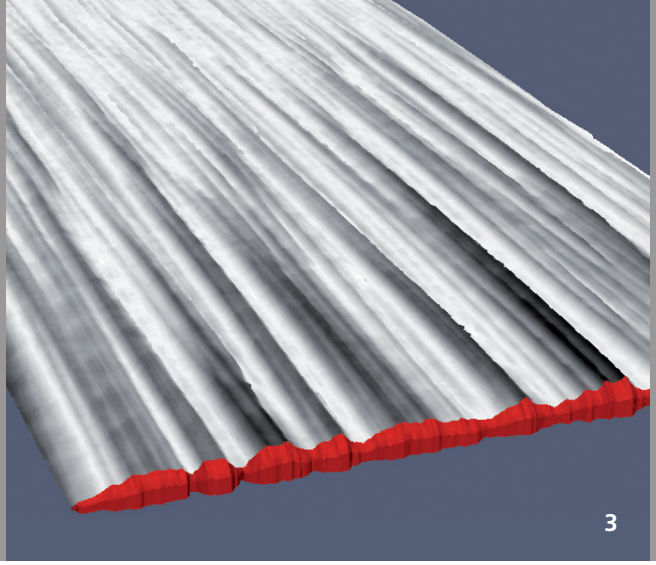
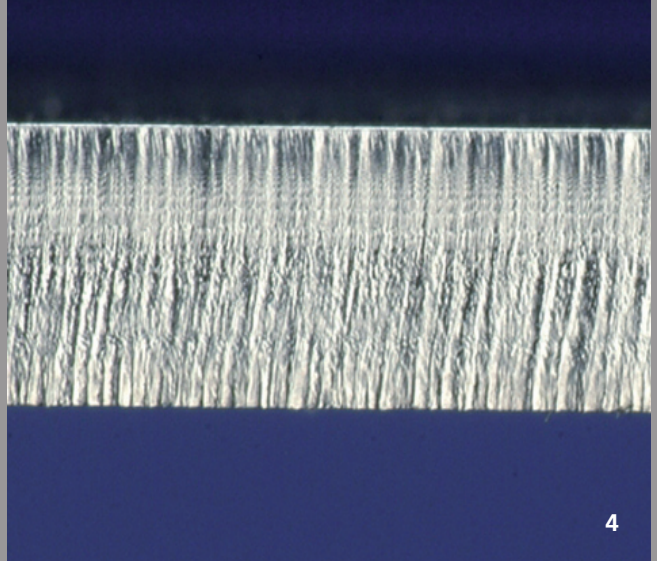


3



4

SURFACE ROUGHNESS IN LASER CUTTING

Task

Minimal roughness and the visual appearance of the cut edge are key quality requirements when laser cutting sheet metal. The optimal cutting parameters are being determined in an extensive series of experiments.

Up to now fluctuations in the process parameters, such as laser output, have been regarded as the sole cause of surface roughness. Mathematical analysis shows, however, that even if the process parameters are ideally constant, roughness can be caused by unstable flow of the melt.

The aims are to provide a model-based prediction of the cut edge quality, to determine the relevant influencing variables and to establish the optimal cutting parameters.

Method

The key variables for the spatial distribution of roughness on the cut edge are calculated using a cutting model. By means of a stability analysis the factors that cause and suppress the defect are calculated as a function of the cutting parameters. The stability limits are analyzed and the process domains for stable cutting determined using the mathematical method.

In numerical simulations based on the cutting model the dynamics of the melt flow are calculated as a function of the process parameters. The predictions from the simulation are validated by comparing them with experimental data.

Result

The newly developed QuCut simulation software permits a space-time analysis of the melt flow and its effect on the cut edge quality. It also enables the optimal cutting parameters to be determined and measures for stabilizing the melt flow to be derived.

Applications

The results will benefit manufacturers and users of laser cutting systems.

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3 Ripples simulated using QuCut.

4 Ripples in an actual cut edge.