



INTERACTIVE SIMULATIONS FOR CUTTING AND DRILLING WITH LASER RADIATION

Task

Simulations are increasingly becoming an indispensable tool for process design and process optimization as the market requirements continue to grow and manufacturing processes become more complex. This applies in particular to laser manufacturing processes. However, today's simulations can be used to examine only a small part of the parameter space due to limited computing capacities. In addition, the integration of process simulations into everyday industrial life has not yet been completed. For example, interactively usable process simulation has not yet been made available to support the machine operator.

Method

On the basis of reduced models, rapid process simulations have been developed and enable operators to examine considerably larger areas of the parameter space. With the aid of the »dense« simulation data generated in this way, »process maps« (so-called meta-models) have been created, which, on the one hand, allow intuitive visualization of parameter dependencies and, on the other, support the development of process optimization. Both the meta-models as well as the fast simulations can be used interactively and have been especially developed for use by the customer on PCs/laptops or on smart devices.

Results

The first application examples were reduced models for the drilling of metallic materials with long-pulsed laser radiation (Fig. 2) as well as for describing the stability properties of the melt film (Fig. 3) and the associated scoring during fusion cutting. Both models were implemented in real-time simulations and are offered by Fraunhofer ILT as license software.

Applications

The methodology of reduced modeling (controlled reduction of model complexity) and the techniques of meta-modeling can be applied to all areas of modeling, and thus to all processes (not only in the field of laser technology).

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- 2 Comparison between simulated hole contour and experimental result. The color scale describes the beam distribution.
- 3 Stability function (> 0: stable, < 0: unstable) via focus (horizontal) and cutting depth (vertical). The gray stripe represents the workpiece.