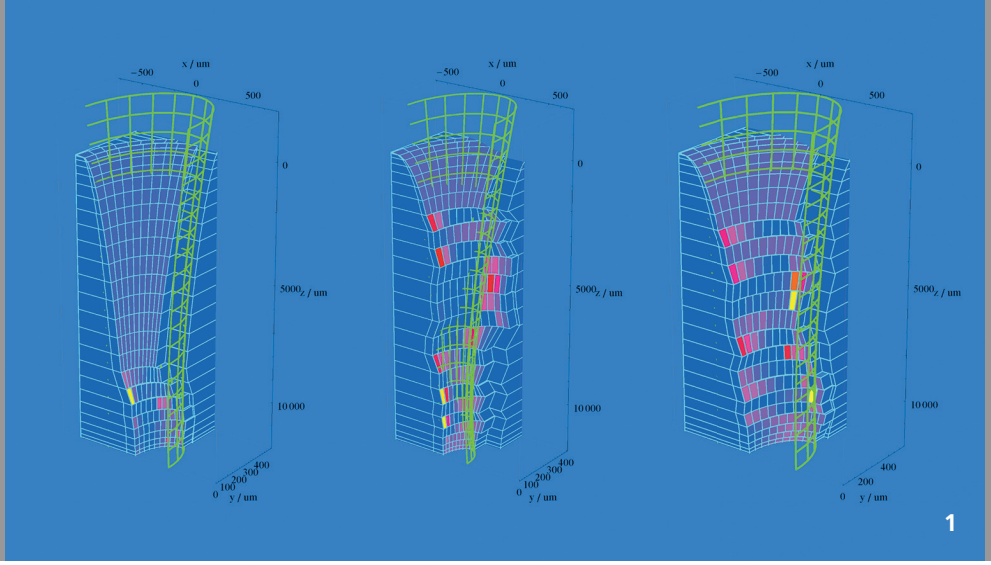

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PROCESS OPTIMIZATION OF LASER CUTTING WITH THE SIMULATION TOOL »CALCuT«

Task

The market for laser cutting systems has seen particularly dynamic development for nearly 10 years. Meanwhile, almost all of the cutting machine manufacturers provide systems with fiber-coupled laser sources. Their market share has already risen to over 50 percent of the total annual sales of flatbed cutting systems. While CO_2 lasers are the second choice for thin sheets, for the cutting of thick stainless steel sheets, they remain unbeatable in terms of the high cut edge quality they achieve. If, however, the development of fiber laser cutting is to advance further, more than just empirical parameter variations are required. To develop new process technologies and beam forming concepts and to successfully implement them with the customer, Fraunhofer ILT has been using the simulation software »CALCut« for a long time.

Method

Since »CALCut« can factor in a unique scope of physical sub-processes, it can be used to calculate the three-dimensional steady-state cutting front geometry and the resulting kerf geometry while also allowing for the following parameters: material, material thickness, laser wavelength, beam quality, beam power and distribution, polarization, raw beam diameter, focusing optics, focal length, focus position, type and pressure of cutting gas, as well as the cutting speed. »CALCut« identifies the spatial distribution of the absorbed laser power density, the temperature, the expansion and flow velocity of the melt film as well as the evaporation rates and pressures. The maximum cutting speed is determined by automatic iteration.

Result

The process model underlying the simulation software »CALCut« describes the stationary solution as a function of the selected process parameters. Recent studies now show that even the cut edge quality, for example, its degree of roughness and dross formation, can be predicted from »CALCut« calculations.

Applications

An issue currently much discussed concerns the influence of different laser beam distributions on the quality of the cut. Simulations with »CALCut« provide sound guidelines for developing optimized, beam distributions adapted to the cutting job and that can be used in future laser cutting systems.

Contact

Dr. Dirk Petring
Telefon +49 241 8906-210
dirk.petring@ilt.fraunhofer.de

1 Simulated cutting fronts for different beam distributions.

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
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