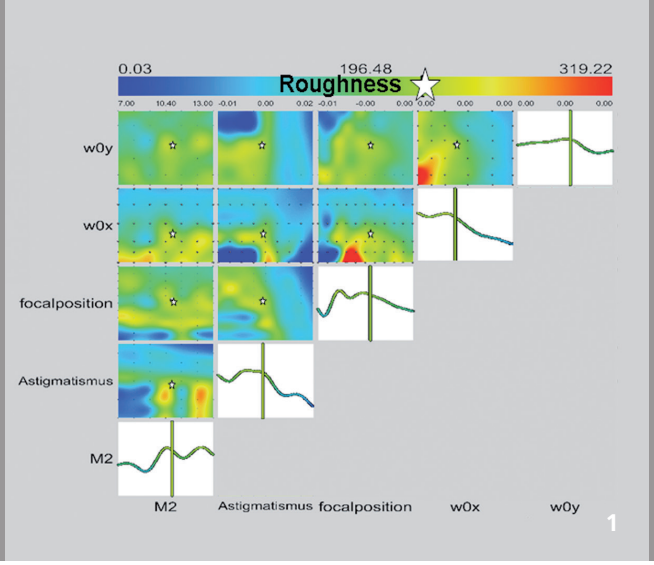
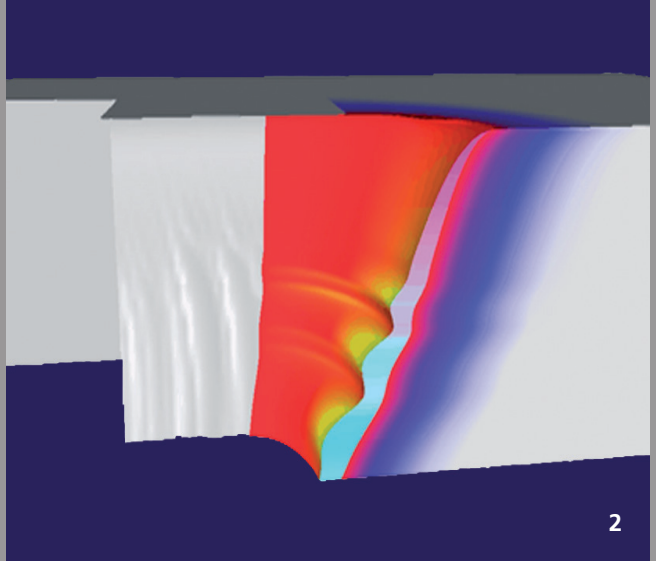


1


2

METAMODELING AND PARAMETRIC OPTIMIZATION OF LASER CUTTING

Task

The parameters of an elliptic laser beam used for laser cutting and, consequently, the parameters of the beam-shaping optical system were the subject of a numerical analysis which aimed to optimize the design of the beam-generating optics in terms of cut edge roughness.

Method

The analysis began by creating a so-called multi-dimensional process map with the beam parameters of a laser beam with an elliptical intensity profile, which was done with the help of an already developed cutting model (see Figure 2). This was followed by a sensitivity analysis and an automated or optionally interactive search for optimum values in the parameter space. Exploring this five-dimensional parameter space examined in this case is unthinkable without the virtual process map. In cooperation with the Virtual Reality Group at RWTH Aachen University, Fraunhofer ILT has been working on a user-friendly, interactive display/visualization of the process map within the Cluster of Excellence »Integrative Production« (see www.production-research.de and Figure 1). This way, the technology can also be used for other laser manufacturing processes and even in real production environments.

Result

With the multi-dimensional, so-called process map, which contains the beam parameters of an elliptical beam, it is now possible to explore a continuous representation of how beam properties influence process properties (here: the roughness of the resulting cut edges). This process map is now initially available for the laser-cutting manufacturing process and, moreover, has already been used for the parametric design of a cutting optics in the EU-funded project »HALO« (see www.halo-project.eu). Optimal beam parameters were determined and used to design a new cutting optics.

Applications

The same procedure serves as an example for all laser manufacturing processes in which a parametric optimization is possible and useful. In addition, it is also desirable for processes for which an overview of the solution properties of the corresponding physical system needs to be generated.

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1 Process map of laser cutting generated by simulation.

2 Cutting simulation.

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