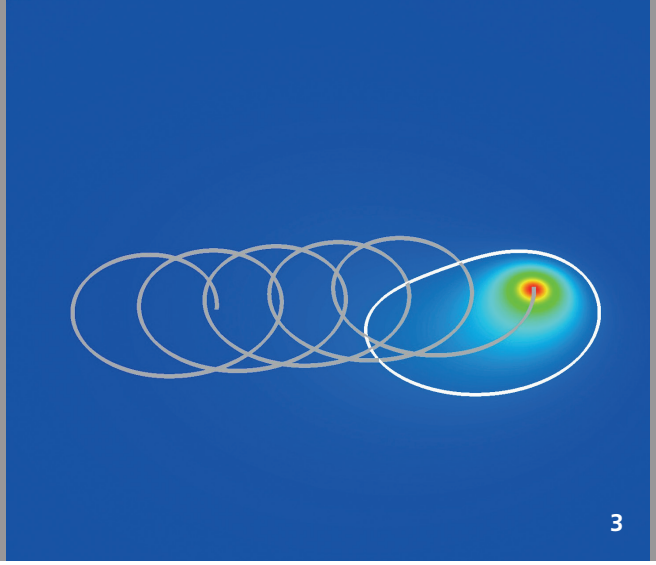
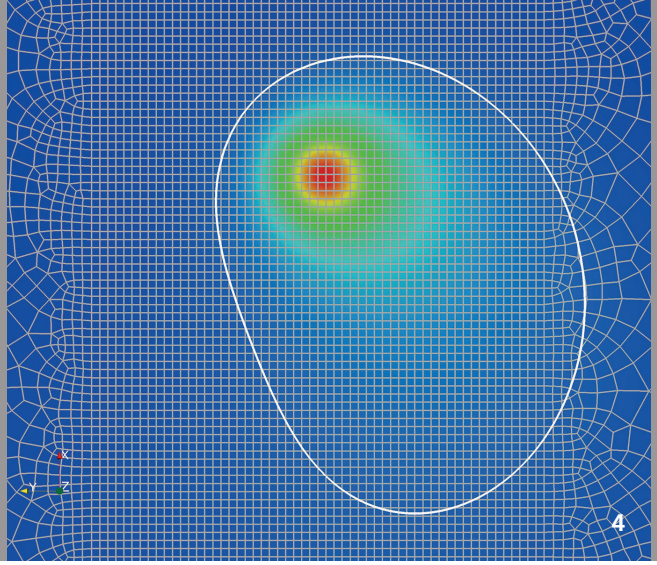


3



4

FAST TEMPERATURE FIELD CALCULATION IN MICRO WELDING

Task

Understanding the temperature distribution present during the welding process is a prerequisite for calculating distortion and residual stresses in the component. The thermal effect of the process on the component can be abstracted by using equivalent heat sources. So that the temperature distribution matches the experiment satisfactorily, it is necessary to calibrate the model parameters of the heat source. Refined mathematical and numerical methods are required to facilitate an automated and fast calibration of these heat source parameters.

Method

Selecting a suitable heat-source model depends to a great degree on the particular task. For the calibration of the heat source parameter, an objective function is formulated which makes it possible to automatically adjust the simulation results to experimental reference data of the micro-welding process. For this task, local optimization methods are used. A significant acceleration is achieved by applying the numerical model reduction method »Proper Orthogonal Decomposition (POD)«. To solve the heat conduction task, Fraunhofer ILT used its own fast parallelized FEM code. The methods applied are characterized by a high degree of flexibility because they do not place any restrictions on the material properties or the component geometry.

Result

A heat-source model was successfully used for the analysis of a melt pool surface on the upper side of a workpiece during laser-beam micro welding with local power modulation. The simulation is capable of imaging oscillations of melting pool surface, which are observable in the experiment and come about because of the changing process control.

Applications

The methods developed allow a fast and reliable calculation of the temperature distribution during laser welding process characteristics such as temperature, stress and distortion during welding.

The work presented here was funded by the German Research Foundation (DFG) within the Collaborative Research Centre 1120.

Contact

Christoph Schöler M.Sc.
Telephone +49 241 8906-8307
christoph.schoeler@ilt.fraunhofer.de

3 Calculated temperature field and presentation of melt pool isotherm during laser micro welding with local power modulation.

4 Top view of the welding process from image 3 with mesh.