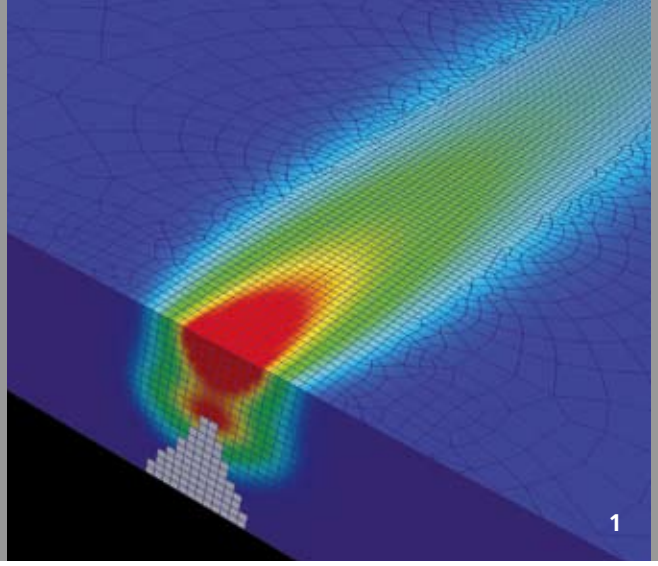

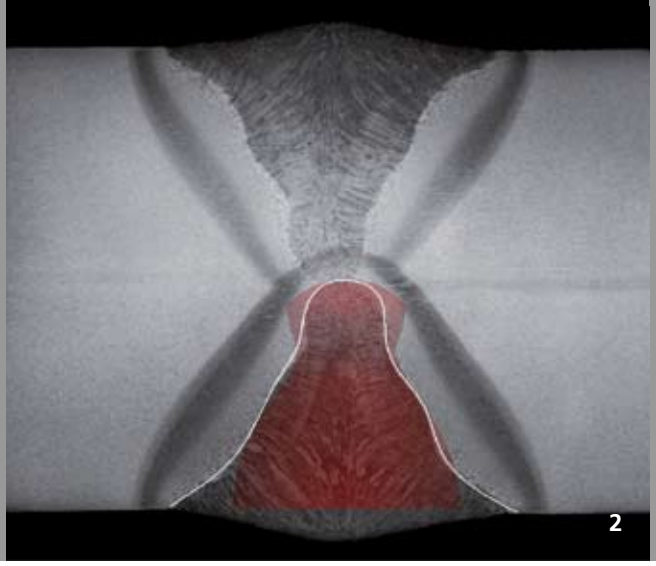

FAST CALIBRATION OF EQUIVALENT HEAT SOURCES FOR WELDING

Task

Knowledge of the temperatures generated in a component during welding is a prerequisite to calculate material's tendency to distort and crack. To date, the use of simulation software for welding has been reserved mostly for experts since the effect of the process upon the temperature field in the component has to be abstracted by an equivalent heat source. A large number of iterative calculations are necessary until a sufficient correlation is found between the temperature field, calculated with an equivalent heat source, and the experiment. The more time the calculation of a model needs, the smaller, therefore, its applicability in an industrial environment is. The aim here is to calibrate the heat sources quickly and automatically with simultaneously increased precision in order to improve the applicability of the welding simulation.

Method

To calibrate the parameter values for the heat source, optimization processes are used. A method for numerical model reduction – the proper orthogonal decomposition (POD) – is applied to accelerate this process. On account of its flexibility, the POD method does not have any limitations regarding the material properties or component geometry.

Result

Compared to conventional R&D processes, the numerical process developed here provides significant time savings. This way, within a few hours, the parameter values of a volume source can be automatically specified with a controlled error. The applicability of the methods used here is independent of the welding process as well as of the material. When the parameter values for the heat source are determined both automatically and reliably, the calibration phase by an expert, which would consume both time and money, can be omitted.

Applications

The methods developed here enable an automated, fast and reliable calibration of parameterized heat sources. This is the basis for an efficient welding simulation to predict process quality properties such as stress, distortion and tendency to crack.

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1 Temperature field calculated with POD for two-layer gas metal arc welding.
2 Comparison of simulation and experiment on a macro polish of the two-layer gas metal arc welding for the underbead.

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