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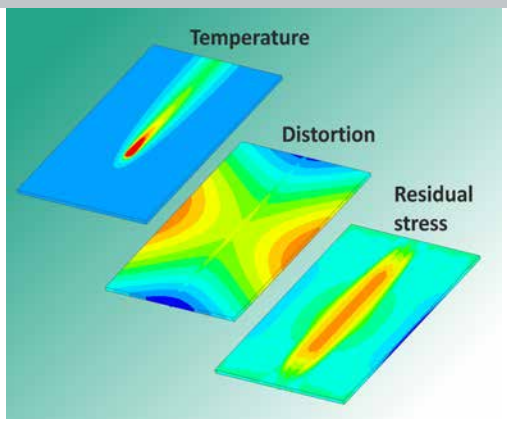

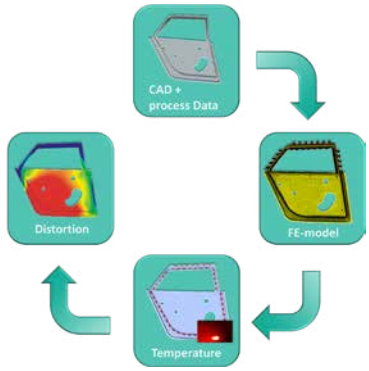

Results of a welding simulation / Overview of process steps using the example of a car door

WELDING SIMULATION

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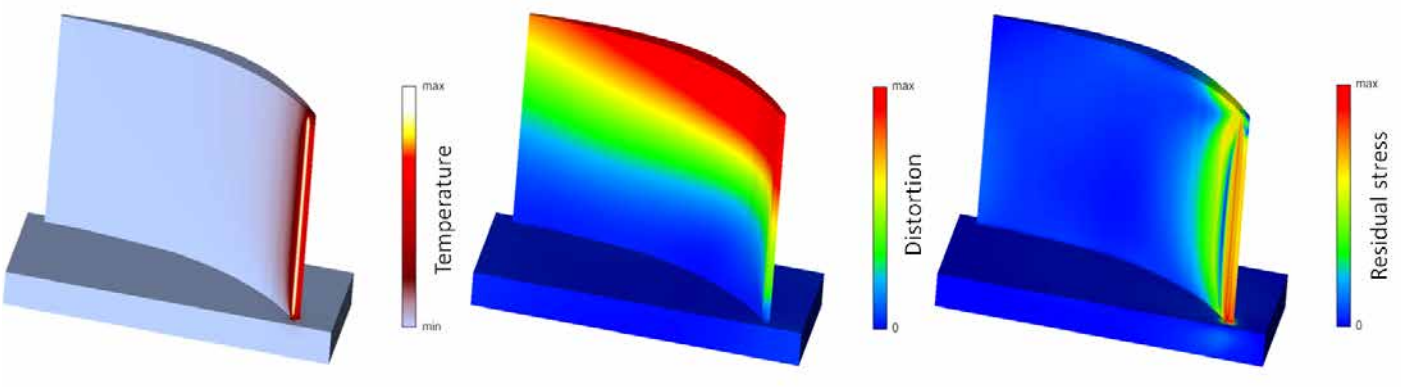
Ensuring the reliability of technical production stages by virtual means is becoming increasingly vital in the product development process given the insistent demand for quality components and shorter development cycles. The distortion and residual stresses caused by welding can have a significant effect on the final dimensions and service life of welded parts. Numerical simulation of the welding process enables these negative side effects induced by thermal welding to be pinpointed and analyzed on the computer so that countermeasures can be put in place before any real damage is done. In other words, welding simulation offers the opportunity of reacting to potential problems in a very early stage of the development cycle.

A vast array of physical non-linear factors must be considered in welding simulation which makes it a field of daunting complexity. Nowadays, commercial software products in this specialist field are designed so that even non-experts can use them. However, since not only the actual performance of a welding simulation but also the quality of results it produces can vary enormously from case to case, it is always advisable to validate and adapt the methodology before opening up a new field of application. In this context a key role is played by the measuring and systems technology needed for transient extensive measurement of the physical parameters such as component temperature and distortion.



Welding simulation for laser powder cladding

Once the methods have been validated as fit for their particular purpose, welding simulation gives users a powerful virtual tool that boasts a whole raft of advantages when compared with conventional purely experiment-based approaches:

- Analysis and visualization of a broad spectrum of physical parameters enables a comprehensive »in the round« understanding of the process.
- Unconventional variants (changes to component geometry, systems technology, etc.) can be virtually tested with minimum investment risk.
- Technical welding problems can be identified and effective countermeasures developed at an early stage of the development cycle, long before the first prototypes are built.

In the modern industrial environment such advantages are mainly taken up by the automobile industry, which uses them to lower development costs and shorten development cycles. Yet welding simulation can be applied with equal advantage to a great many other fields. Fraunhofer IPK, for instance, is currently engaged in validating the methodology for laser powder cladding, a technique that can be used for instance to repair components. An optimized construction strategy has been proposed for this use case which ensures that the additive repair process will only induce minimum residual stress and distortion in the component part.

Our expertise

The wealth of experience and expertise we have accumulated over the past few years in the practical application of welding simulations for industrial components now enables us to make reliable predictions about the distortion behavior of such components as body shell parts in the automobile industry. Such statements enable us to evaluate single production variants – deploying different welding sequences, for instance, or clamping technologies – in terms of their propensity to distortion and residual stress.

Fraunhofer IPK together with its partners can draw on a rich and comprehensive range of systems and measurement technology and analytics. In-depth expertise in the field of measurement technology combined with our experience in finite element method (FEM) simulation position us to validate and adapt welding simulation to an almost unlimited range of application scenarios. Our research work is based on standard, specialized and commercially available software products (such as simufact.welding), while the close contact we maintain with developers ensures that any modification called for by specific application scenarios can be carried out in a timely manner with no delays.

Our services

We offer our customers a broad and needs-oriented range of services both for the application of welding simulation to specific cases and its extension into new fields of application. Our service range begins with consultancy and feasibility studies and covers all subsequent stages through to implementation of the technique in the existing processes. Working in close collaboration with the customer, we ground project goals on a solid scientific foundation and drive development all the way to operability. We advise our customers about the various means by which welding simulation can be used in their specific companies, inform them of the resultant benefits and evaluate the economic applicability of the simulation methodologies.

Your benefits

Our research and development services aim to assure the cost-effective use of welding simulation. Welding simulation holds enormous potential in reducing development times and lowering costs. Outsourced feasibility studies pinpoint this potential for your specific application case and thus eliminate high investment risks. And the close bonds between basic research and applied research at Fraunhofer IPK assure you the very best solutions for all your individual applications.