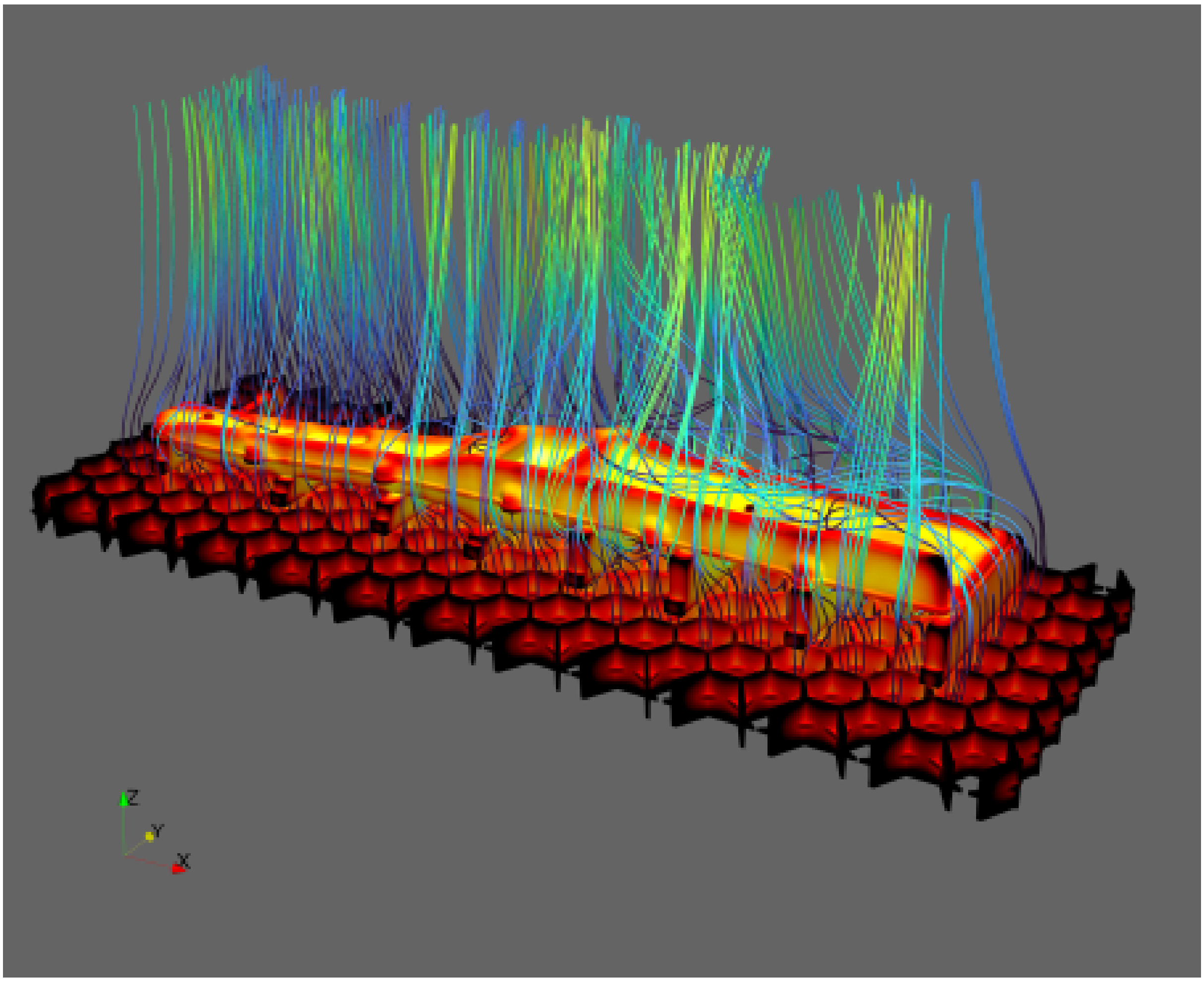
Manufacturing titanium components precisely and resource-efficiently: simulation reduces distortion

About this project



SimProTi

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Markets:

Material: Titanium

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About this project

This project is funded by the Technology Transfer Programme Leichtbau (TTP LB) of the Federal Ministry of Economics and Energy.

Technology Transfer Program Leichtbau

Context

The aviation industry is focussing on lightweight construction to make aircraft more efficient and environmentally friendly. Titanium is a key material here: it offers high strength, corrosion resistance and temperature resistance at a low weight. However, its production is resource-intensive: up to 90 per cent of the valuable raw material is removed by machining before a component reaches the desired shape.

This enormous loss of material causes high costs and has a negative impact on the environment. This is where the SimProTi research project comes in. The aim is to make the production of titanium components more efficient, more precise and more resource-friendly.

Purpose

The project team is pursuing the goal of fundamentally improving the production of lightweight titanium components using digital technologies. To this end, the researchers are developing an innovative simulation methodology that precisely predicts the distortion of components during heat treatment. The aim of SimProTi is to use state-of-the-art simulation methods to precisely model the influence of temperature and environmental conditions.

This digital support enables companies to reduce material usage by up to 10 per cent. The economic benefits are considerable: OTTO FUCHS can save around 40 tonnes of titanium per year and thus considerable material costs. At the same time, optimised production ensures a reduction in energy consumption and therefore also a reduction in CO# emissions.

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Procedure

The project team used computational fluid dynamics (CFD) simulation in combination with finite element structural simulation to analyse the cooling process after heat treatment in detail. Researchers recorded temperature curves and deformation states during the critical cooling phases. Using this data, they developed a digital twin that simulates distortion and stress patterns in titanium components with a high degree of accuracy.

The process enables companies to control heat treatments in a targeted manner and avoid distortion problems in advance. At the same time, the team was able to significantly reduce material requirements as the components can already be manufactured in near-net-shape form. The results show: Optimised cooling processes lead to more homogeneous stress states, less reworking and significantly fewer rejects. Beyond aviation, these methods can be transferred to other sectors, such as the automotive and aerospace industries.

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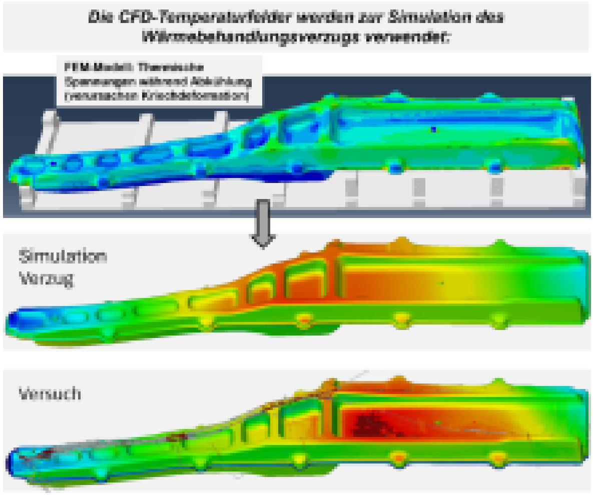

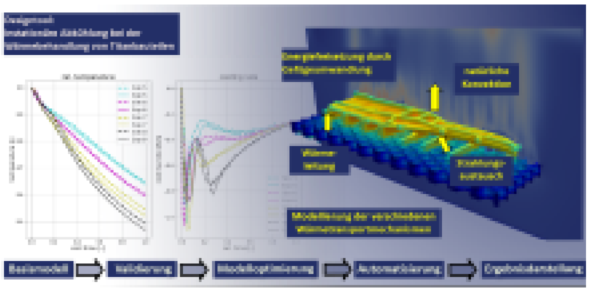

Funding duration:

Funding sign:	03LB1007	**Funding amount:**	EUR 307 thousand

Final report

Further websites

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Project coordination

Contact:

Mr Dr.-Ing. Volker Hardenacke

+49 2354 73-4942

volker.hardenacke@otto-fuchs.com

Organisation:

OTTO FUCHS KG

Derschlagerstrasse 26
58540 Meinerzhagen
North Rhine-Westphalia
Germany

www.otto-fuchs.com

English (EN){{ Projektpartner }}

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Software & databases	✓
Services & consulting Consulting, Simulation	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout	
Functional integration	
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography)	✓
Modelling and simulation Multiphysics simulation, Optimisation, Processes	✓
Plant construction & automation	
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming Forging	✓
Joining	
Material property alteration Heat treatment	✓
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Titanium	✓
Plastics	
Structural ceramics	
(Technical) textiles	