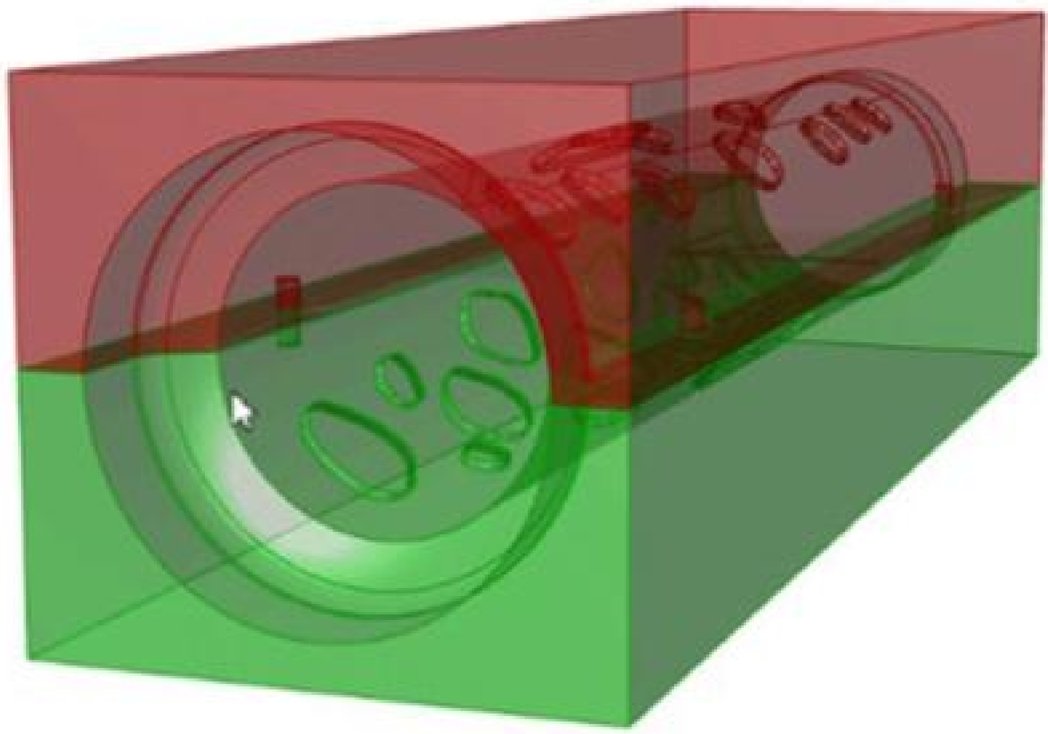
Efficient design of fibre composites: digital model for tailored fibre placement

About this project



DigiPEP

Efficient design of fibre composites: digital model for tailored fibre placement

Markets:

Material: Carbon fibres, Natural fibres, Thermoset plastics, Carbon-fiber reinforced plastics (CFRP), Others (TFP)

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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

Fibre-reinforced plastics enable lighter and more efficient components. They play a key role in the mobility and industry of the future. Tailored fibre placement (TFP) in particular offers great potential: it enables the precise placement of reinforcing fibres along the main stresses in the component. This results in highly resilient structures with minimal use of material.

However, the industrial application is complex. The development of a TFP component requires many iterations, as design, production and mechanical properties are closely interlinked. Small and medium-sized enterprises (SMEs) in particular face challenges: High development costs and a lack of digital tools make it difficult to access the technology. This is where the DigiPEP research project comes in, developing a digital solution that fundamentally simplifies the development process.

Purpose

The aim of DigiPEP is to create a holistic, digital development process for TFP components. To achieve this, the project team is linking the individual steps from component design and production through to cost and sustainability assessment. The aim is to create an efficient, automated and user-friendly solution.

The researchers want to link all relevant design steps in a Model-Based Systems Engineering (MBSE) approach. In this way, they want to optimise structural, manufacturing and economic aspects in parallel. The model takes into account mechanical loads, fibre orientation in the embroidery pattern, draping influences and failure mechanisms. This significantly reduces the iterative development effort.

The digital model should enable optimum material utilisation, reduce waste and thus lower costs. An integrated life cycle assessment should enable companies to make sustainable decisions in the early planning phase.

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Procedure

The researchers are initially developing sub-models for structural analysis, stick-path design, drape simulation and failure assessment. Mechanical tests on material samples provide precise data for modelling the material properties. The team also analyses the placement and draping behaviour of different fibre types under varying production parameters. This experimental data is incorporated into an AI-supported draping model that realistically depicts fibre displacement during forming. Finally, the researchers bring together all the sub-models in a networked system environment.

The project team tests and validates the model using a demonstrator component from the manufacturing industry. The results flow directly into the software development. In this way, the researchers aim to provide a practical software solution that enables the economical and load-path-compliant design of TFP components.

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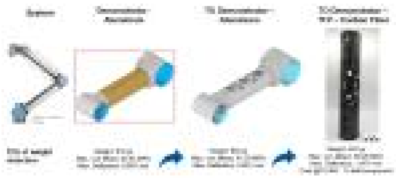
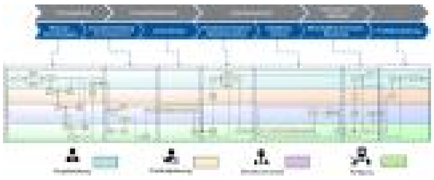
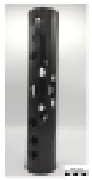
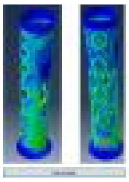
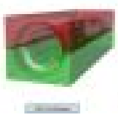


Funding duration:

Funding sign:	03LB3063	**Funding amount:**	EUR 1.2 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3063A - DigiPEP in the federal funding catalogue

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Project coordination

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Software & databases	✓
Services & consulting Consulting, Testing and trials, Engineering, Prototyping, Simulation, Technology transfer	✓
Field of technology	
Design & layout Lightweight manufacturing, Lightweight construction concepts	✓
Functional integration	
Measuring and testing technology	
Modelling and simulation Loads & stress, Life-cycle analysis, Optimisation, Structural mechanics	✓
Plant construction & automation	
Recycling technologies	

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology Resin infusion process, Vacuum infusion	✓
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology Preforming, Others (Tailored Fibre Placement)	✓
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Carbon-fiber reinforced plastics (CFRP)	✓
Fibres Carbon fibres, Natural fibres	✓
Functional materials	
Metals	
Plastics Thermoset plastics	✓
Structural ceramics	
(Technical) textiles Others (TFP)	✓