Reduce material scattering: precise analysis with 3D digital twin

About this project

RICA

Reduce material scattering: precise analysis with 3D digital twin

Markets:

Material: Glass fibres, Carbon fibres, Thermoset plastics, Thermoplastics, Yarns, rovings, Laid webs, Woven fabrics, Nonwovens, mats, Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP), Short fibre-reinforced concrete, Nanocomposites, Textile-reinforced concrete

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

Technology Transfer Program Leichtbau

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Context

Fibre composites such as carbon fibre plastics (CFRP) are indispensable for lightweight construction. They are used across all industries, particularly in aerospace and automotive engineering. Despite their outstanding properties, however, they exhibit a wide range of mechanical characteristics.

These fluctuations make it necessary to oversize components in order to guarantee safety. This not only increases the weight, but also the consumption of resources and CO# emissions - both during production and operation. Reducing these material variations is essential in order to fully utilise the lightweight construction potential and reduce the environmental impact.

Purpose

This is precisely where the RICA research project comes in. The aim is to better understand the variation in material properties and reduce it. By precisely analysing influencing factors such as fibre angle, fibre volume content and degree of hardening, the project team aims to identify the causes of the variability.

With these findings, the researchers are developing digital tools to better predict the material properties. The aim is to make components lighter and more resource-efficient without compromising on safety. The use of digital twins should also ensure that these improvements can be applied over the entire service life of the products.

Procedure

The project team combines advanced simulation methods with comprehensive material analysis. Using digital image correlation, the researchers record detailed strain and stress fields in three dimensions. This makes it possible to precisely determine the breaking strength, stiffness and elongation at break, even under complex loads. The analysis includes not only global material properties, but also local influences such as layer structure and micro-damage.

At the same time, the team is developing digital twins that realistically depict material behaviour. Virtual tests replace many physical tests, which means that fewer samples and resources are required. Thanks to these innovative approaches, the researchers can not only develop lighter components, but also set new standards for material testing and the simulation-based design of lightweight structures.

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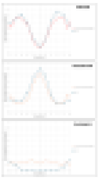

Funding duration:

Funding sign:	03LB3009	**Funding amount:**	EUR 2.4 million

Final report

Further websites

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Project coordination

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Semi-finished parts, Machines and plants, Software & databases, Systems and end products, Materials	✓
Services & consulting Training, Consulting, Testing and trials, Funding, Engineering, Prototyping, Validation, Simulation, Technology transfer	✓
Field of technology	
Design & layout Lightweight manufacturing, Lightweight design, Hybrid structures, Lightweight construction concepts, Lightweight material construction	✓
Functional integration Thermal activation, Material functionalisation	✓
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography), Materials analysis, Destructive analysis, Non-destructive analysis	✓
Modelling and simulation Loads & stress, Multiphysics simulation, Optimisation, Structural mechanics, Materials	✓
Plant construction & automation Plant construction, Automation technology, Handling technology	✓
Recycling technologies Material separation, Recycling, Upcycling	✓

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology Filament winding, Manual lamination, Resin infusion process, Resin transfer moulding, Pre-preg processing, Vacuum infusion	✓
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating Drilling, Turning, Milling, Electrical discharge machining, Sawing, Grinding, Cutting	✓
Textile technology Fibre manufacturing, Yarn & roving production, Preforming, Textile surface treatment and finishing, Nonwoven & mats production, Weaving, Knitting, laid web production	✓

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites Glass-fiber reinforced plastics (GFRP), Carbon-fiber reinforced plastics (CFRP), Short fibre-reinforced concrete, Nanocomposites, Textile-reinforced concrete	✓
Fibres Glass fibres, Carbon fibres	✓
Functional materials	
Metals	
Plastics Thermoset plastics, Thermoplastics	✓
Structural ceramics	
(Technical) textiles Yarns, rovings, Laid webs, Woven fabrics, Nonwovens, mats	✓