Combining processes in a targeted manner: Hybrid additive manufacturing design methodology

About this project

KREATIVE

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Markets:

Material: Aluminium, Steel

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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

When it comes to manufacturing lightweight metal components, established production processes are increasingly reaching their limits. Machining processes often result in significant material loss, whilst additive processes – depending on the technology – are either constrained by long build times and limited build volumes, or can only produce comparatively coarse structures.

Powder-bed-based manufacturing approaches enable delicate and internal structures, but are costly and time-consuming. Wire-based processes achieve high build rates and allow for large components, but cannot reproduce fine geometries or complex internal structures.

Hybrid additive manufacturing combines these methods or integrates additive processes with conventional ones. This allows different requirements to be specifically met within a single component. To date, there has been a lack of comprehensive design approaches for this application, particularly regarding component selection, the division into manufacturing zones and the design of the transitions between processes.

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Purpose

In the KREATIVE project, the partners are developing a design methodology for hybrid additive manufacturing. They are devising a structured approach to evaluate components, select suitable manufacturing processes and combine these in a targeted manner within a single component.

The methodology supports the design of components with regard to function, cost and resource efficiency. It integrates design approaches with simulation and optimisation tools to ensure manufacturability at an early stage and reduce development costs.

Another focus is on assessing environmental impacts. To this end, the researchers are developing approaches to estimate material usage and potential CO# savings. They are testing the methodology using demonstrator components, including handling components for sheet metal processing and components from screw-fastening systems with high potential for integration and lightweight construction.

Procedure

First, the project team develops a systematic approach to identify suitable components and categorise them into design ranges suitable for manufacturing. In doing so, the team takes into account the specific constraints of the respective manufacturing processes.
On this basis, the researchers develop component designs. They combine traditional design methods with computer-aided approaches such as topology optimisation to generate material-efficient and functionally appropriate geometries.

At the same time, they build simulation models that can be used to predict thermal and mechanical effects during manufacturing. The results are continuously incorporated into the design process to prevent warping, process failures or unsuitable designs at an early stage.

The participants conduct experimental tests on the manufactured demonstrator components, for example to assess their load-bearing capacity, wear and the properties of the joints. Finally, they evaluate the solutions in terms of cost-effectiveness, resource usage and transferability, and translate the findings into a practical methodology.

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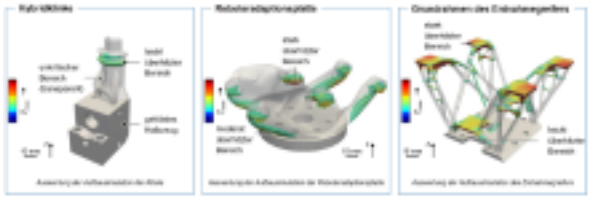

Funding duration:

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Project coordination

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Stöger Automation GmbH

Lightweighting classification

	Realisation
Offer	
Products Parts and components, Tools and moulds	✓
Services & consulting Engineering, Prototyping, Simulation	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight manufacturing, Lightweight design, Hybrid structures	✓
Functional integration Media conductivity	✓
Measuring and testing technology Component and part analysis, Visual analysis (e.g. microscopy, metallography), Destructive analysis, Non-destructive analysis	✓
Modelling and simulation Multiphysics simulation, Optimisation, Processes, Structural mechanics	✓
Plant construction & automation Plant construction, Automation technology, Handling technology	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing 3D printing, Deposition welding, Selective laser melting (SLM, LPBF, ...)	✓
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration Heat treatment	✓
Primary forming	
Processing and separating Drilling, Turning, Milling	✓
Textile technology	

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Lightweighting classification

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