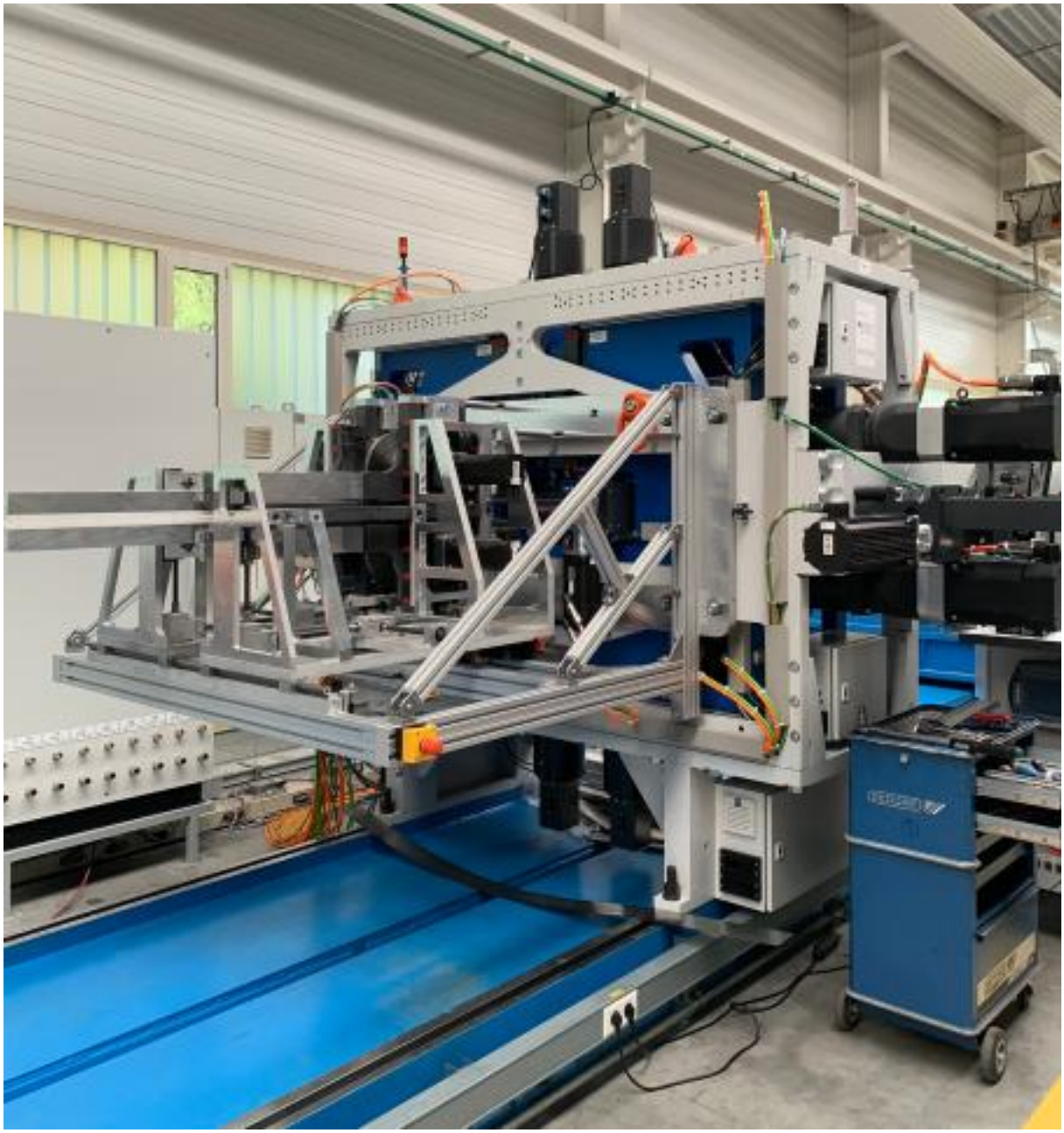
Stable and light: producing bionic lightweight structures based on branched sheet metal

About this project



BioStruX

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About this project

Markets: 

Material: Steel

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

Sheet metal and profile structures play a central role in many industrial applications - especially in vehicle and mechanical engineering. However, their load-bearing capacity is limited. Under load, the thin-walled profiles often deform in an uncontrolled manner - they buckle or bulge. To avoid such instabilities, reinforced cross-sections have been used up to now. However, these increase material consumption and weight - a contradiction to the goals of resource-efficient lightweight construction.

New design approaches are therefore needed that enable sufficient stability without additional material. One promising approach can be found in nature: biological structures utilise branching to increase rigidity and load-bearing capacity. These bionic principles can be transferred to technical applications and open up new potential for lightweight construction.

While such branched structures can already be implemented with materials such as aluminium, their realisation with thin-walled steel has so far posed major challenges for the industry. This is where the BioStruX project comes in: The aim is to make structurally effective branching usable for steel profiles and to be able to produce them economically and flexibly.

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Purpose

The BioStruX project team is working on further developing the forming production process of gap profiling with subsequent upright bending so that it can be used on an industrial scale. With the help of this technology, the researchers want to produce sheet metal profiles directly and flexibly from steel for the first time, based on a bionic model. The branched shape makes these new profiles significantly more stable - with the same weight. In addition, the forming process increases the strength and hardness compared to the original raw material. This enables companies to produce sheet metal with tight bending radii and low springback. Slit profile bending produces particularly robust components that can withstand high loads.

To achieve this goal, the scientists are designing a fully digitalised, automated and flexible process chain. Their aim is not only to simplify production, but also to open up new applications in sectors such as commercial vehicle construction, rail transport and logistics. In the long term, they want to develop the technology to such an extent that it can be used economically in series production.

Procedure

The project team is designing a new type of gap profiling system that integrates all forming steps into a single, flexible forming stand. Instead of classic, multi-stage rolling processes, the researchers are focussing on a single-stage process with a reversing feed mechanism. This feeds the sheet metal through the same forming stand several times with customised infeeds, enabling the flexible production of complex profiles.

The scientists are focussing in particular on the development of an intelligent process control system. Using comprehensive sensor technology, they record the process status and continuously optimise it during operation. This reduces the time required to set up the system when changing products. In addition, the forming stand automatically adapts to different materials and geometries.

The team is also developing a new bending process that allows customised curvatures to be integrated directly into the profiles. The partners are combining both sub-processes - gap profiling and gap profile bending - in an AI-supported overall system. Using demonstrators and industry-specific application scenarios, the researchers are testing the practical suitability of the technology.

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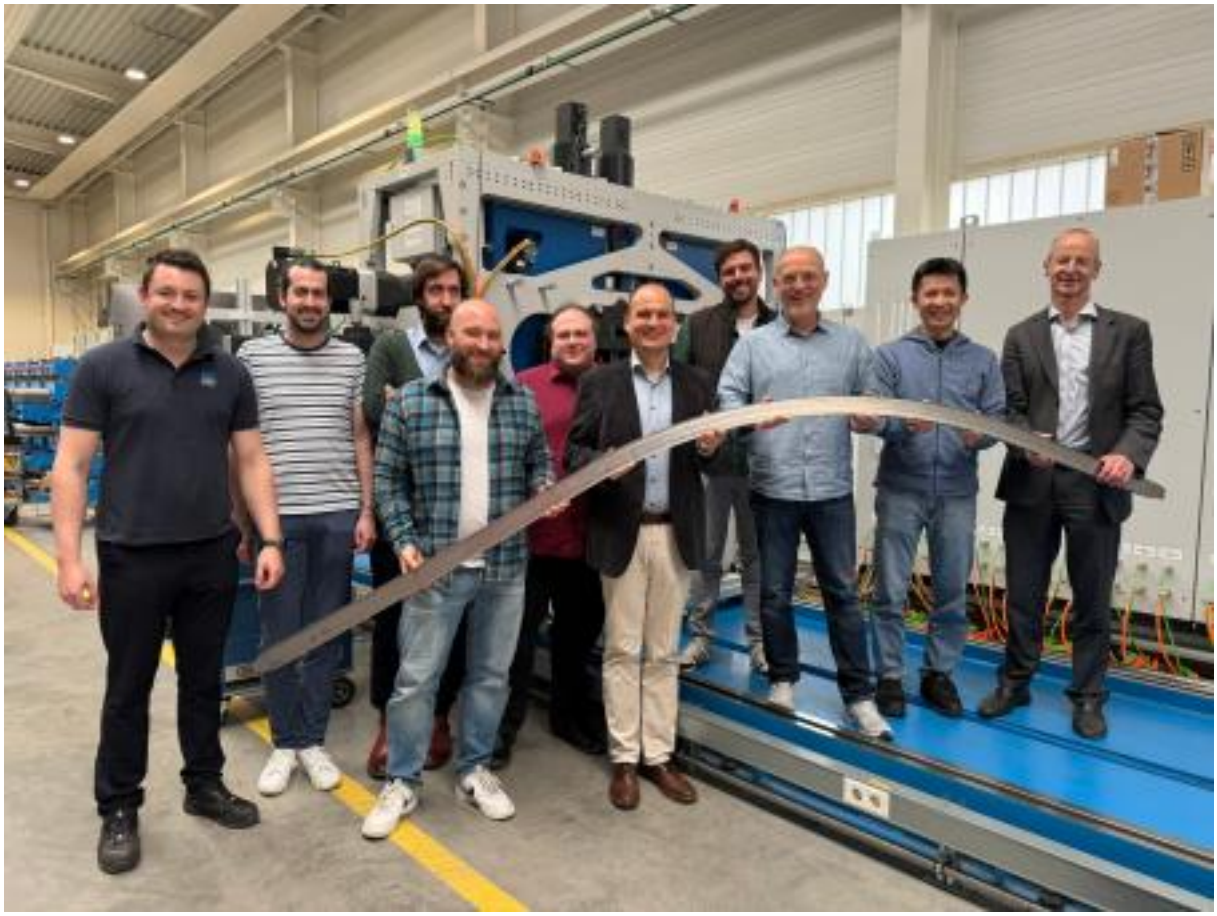

Funding duration:

Funding sign:	03LB2011	**Funding amount:**	EUR 3.3 million

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB2011A - BioStruX in the federal funding catalogue

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Project coordination

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IDA - Smart Digital Solution GmbH

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Machines and plants	✓
Services & consulting Training, Testing and trials, Engineering, Prototyping, Technology transfer	✓
Field of technology	
Design & layout Lightweight manufacturing	✓
Functional integration	
Measuring and testing technology	
Modelling and simulation Crash behaviour, Processes	✓
Plant construction & automation Plant construction	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming Bending, Rolling	✓
Joining	
Material property alteration	
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 Steel	✓
Plastics	
Structural ceramics	
(Technical) textiles	