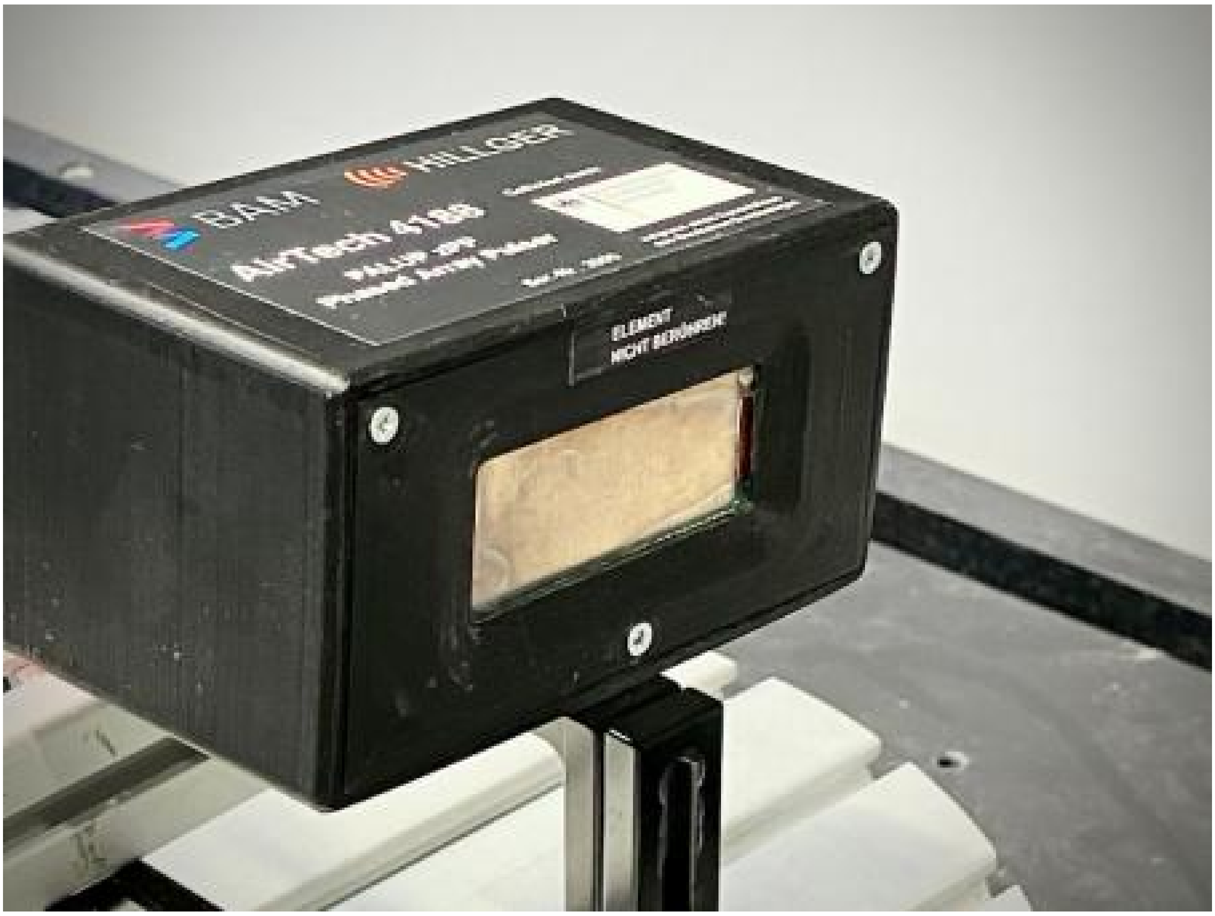
Air-coupled ultrasonic testing: damage-free and flexible testing of lightweight components

About this project



PALUP

Air-coupled ultrasonic testing: damage-free and flexible testing of lightweight components

Markets:

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About this project

Material: Bioplastics, Biocomposites, Wood, Piezoelectric materials, Thermoset plastics, Elastomers, Thermoplastics, Aluminium, Intermetallic alloys, Magnesium, Steel, Titanium, Monolithic ceramics, Non-oxidic ceramics, Oxidic ceramics, Ultra-high-temperature ceramics, Aramid fibre composites, Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP), Ceramic matrix composite (CMC), Carbon-fiber reinforced plastics (CFRP), Short fibre-reinforced concrete, Metal-ceramic composite, Metal-fibre-polymer composite, Metal matrix composite, Nanocomposites, Natural fibre reinforced plastics (NFRP), Laminates, Particulate composites, Textile-reinforced concrete

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Technology Transfer Program Leichtbau

Context

The safety inspection of lightweight components is a key challenge in the industry. Current methods use liquid coupling agents such as water to transmit ultrasonic waves into the components. However, these agents have negative effects: They can damage sensitive materials such as honeycomb core structures or foams, increase maintenance costs and make it difficult to inspect complex geometries, especially for components with one-sided access.

Conventional air-coupled ultrasonic methods are technically limited: Single-channel systems do not allow precise control of the sound field and are unsuitable for complex applications. The PALUP project specifically addresses these weaknesses. The team developed an innovative testing technology that does not require any coupling agents at all, yet offers maximum testing accuracy and can be flexibly applied to different component geometries.

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Purpose

With PALUP, the project team is pursuing the goal of developing a demonstrator for an air-coupled phased array system that works entirely without coupling agents. With this technology, sound fields can be electronically focussed, swivelled and scanned. This opens up new possibilities for testing complex geometries and areas that are difficult to access.

The researchers want to create a solution that not only overcomes the existing limitations of air-coupled ultrasound technology, but also transfers the precision and flexibility of phased array technology to a non-contact method. In the long term, this innovation should make lightweight construction applications safer and more sustainable, particularly in safety-critical areas such as aerospace or the automotive industry.

Procedure

The researchers are combining their expertise in sensor development and test device integration to develop a demonstrator with innovative airborne ultrasonic sensors. They are using cellular polypropylene, a material with piezoelectric properties that requires no matching layers and is ideal for the transmission of ultrasonic waves in air. The sensors are designed as phased arrays to enable precise electronic control of the sound fields.

At the same time, the team is developing multi-channel transmitter and receiver electronics as well as specialised software for data acquisition. With this system, the researchers can carry out tests without mechanical movement or coupling devices. The result is a pioneering technology that enables flexible, precise and safe non-destructive testing of lightweight components and creates the basis for a broad industrial application.

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Funding duration:

Funding sign:	03LB1001	**Funding amount:**	EUR 460 thousand
Further websites	foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB1001A - PALUP in the federal funding catalogue		

Project coordination

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English (EN){{ Projektpartner }}

HILLGER

Lightweighting classification

	Realisation
Offer	
Products Semi-finished parts, Systems and end products, Materials	✓
Services & consulting Validation	✓
Field of technology	
Design & layout	
Functional integration Sensor technology	✓
Measuring and testing technology Component and part analysis, Non-destructive analysis	✓
Modelling and simulation	
Plant construction & automation	
Recycling technologies	

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Lightweighting classification

	Realisation
Manufacturing process	
Additive manufacturing	
Coating (surface engineering)	
Fibre composite technology	
Forming	
Joining	
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials Bioplastics, Biocomposites, Wood	✓
Cellular materials (foam materials)	
Composites Aramid fibre composites, Basalt fibre-reinforced plastic, Glass-fiber reinforced plastics (GFRP), Ceramic matrix composite (CMC), Carbon-fiber reinforced plastics (CFRP), Short fibre-reinforced concrete, Metal-fibre-polymer composite, Metal-ceramic composite, Metal matrix composite, Nanocomposites, Natural fibre reinforced plastics (NFRP), Laminates, Particulate composites, Textile-reinforced concrete	✓
Fibres	
Functional materials Piezoelectric materials	✓
Metals Aluminium, Intermetallic alloys, Magnesium, Steel, Titanium	✓
Plastics Thermoset plastics, Elastomers, Thermoplastics	✓
Structural ceramics Monolithic ceramics, Non-oxidic ceramics, Oxidic ceramics, Ultra-high-temperature ceramics	✓
(Technical) textiles	