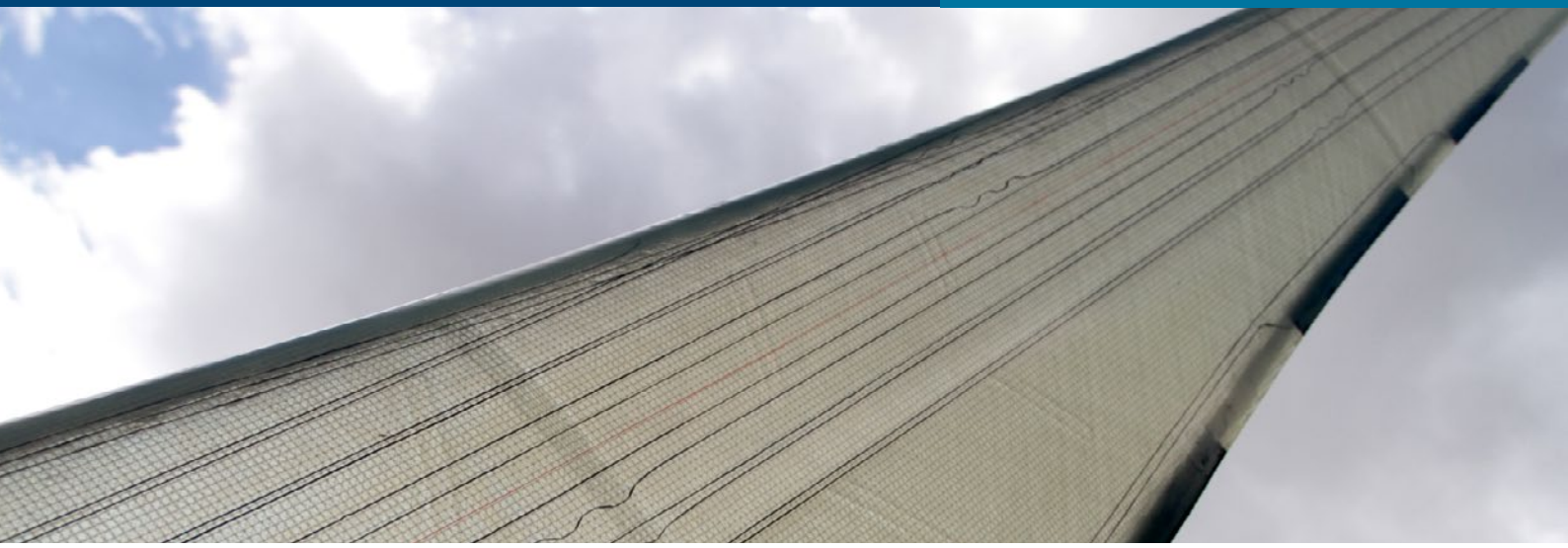
Federal Ministry
for Economic Affairs
and Climate Action

Best practice example

for lightweighting in Germany

Fibre-based in-situ sensors



Rotor blade of a small wind turbine with integrated, textile-based sensor technology tailored to requirements

System reliability with continuous monitoring

Fields of application

- Automotives
- Energy technology
- Machinery and plant construction
- Construction of rolling stock
- Manufacture of other vehicles
- Construction sector
- Aircraft construction
- Commercial vehicle manufacturing
- Shipbuilding

In this example, lightweighting allowed for the following reductions compared to a conventional model made of reinforced concrete:

KG Weight approx. -1% Energy approx. -1% € Cost approx. -2%

Application

Using fibre-based, structure-integrated in-situ sensors, large fibre composite components can be continuously monitored as to the mechanical stress being exerted on them or to any structural degradation that not visible from the outside. In the medium term, this helps to reduce the overdimensioning of composite material structures of this kind and to consolidate system reliability and user confidence.

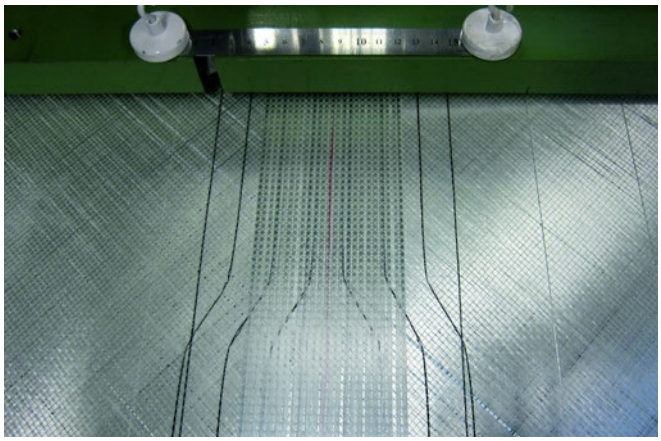
Challenge

Large or hard-to-reach components made of composite materials, such as rotor blades, need to be continuously checked for material fatigue and wear for safety reasons. Until now, these testing procedures have been not only laborious but also high in cost. In this project, a cost-effective, industrially relevant solution was developed.

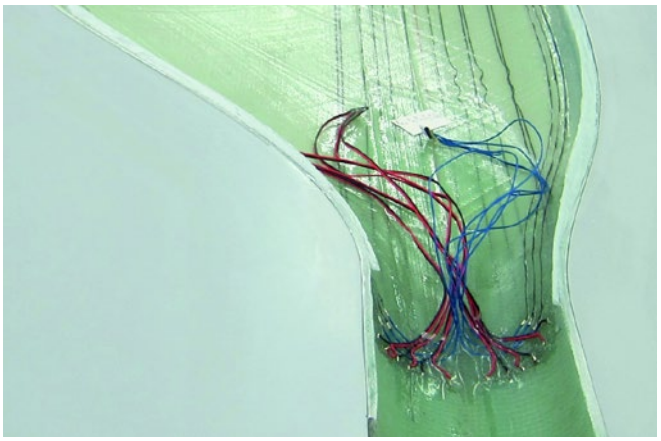
Solution

Fibre-based sensors were developed, which are incorporated during the production of semi-finished reinforcement textiles and then interconnected to form sensory networks. These allow all structurally critical changes to be precisely localised. This means that any potential damage in large components can be detected at an early stage, obviating large costs for subsequent repairs.

Best-Practice-Beispiel | Fibre-based in-situ sensors



Integral production of sensor-functionalised, semi-finished products for smart FRP components



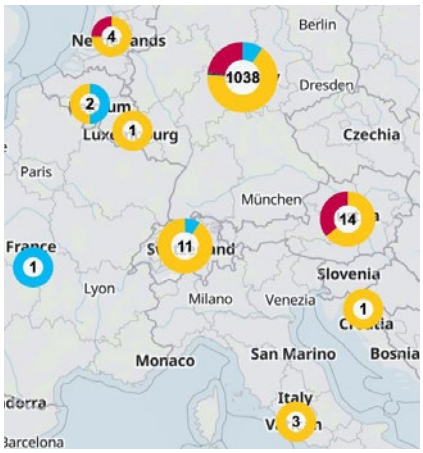
Finished FRP component with structurally integrated, fibre-based in-situ sensor networks for structural health monitoring (SHM) tasks

Other potential applications

Spacecraft construction

The goals of the energy transition, such as the reduction of pollutant emissions, the efficient and sustainable use of resources and the expansion and use of renewable energy sources, are accelerating the development of innovative, lightweight construction methods and technologies. In-situ sensors are also suitable for controlling textile actuators for shape-changing components made of composite materials.

Using an integral manufacturing process based on multiaxial warp knitting technology, functionalised, semi-finished reinforcement textiles provided with textile-based sensor networks for spatially resolved in-situ structural monitoring of highly complex components can be produced based on the use of material-efficient, fibre-reinforced plastic composites. A rotor blade with integrated, textile-based sensor technology for wind turbines was used to demonstrate the potential of this innovation vis-à-vis the goals allocated as part of the energy transition.
Compliance with all requirements relevant for the sector is ensured. Research activities are being conducted so as to further improve health and safety, environmental protection and recycling.



Der LIGHTWEIGHTING ATLAS

The LIGHTWEIGHTING ATLAS is an interactive web portal that pools information on those active in lightweighting and their skills across different industries and materials. The atlas is free to use and entries into the atlas are also free. You can find the LIGHTWEIGHTING ATLAS at www.leichtbauatlas.de

The Lightweighting Initiative

Modern lightweighting is of pivotal importance for German industry and its competitiveness. The Federal Ministry for Economic Affairs and Climate Action has established the Lightweighting Initiative to support lightweighting in Germany. The Lightweighting Initiative Coordination Office in Berlin, which is financed as part of the initiative, pools all activities relevant to lightweighting and supports German companies, especially SMEs, as they implement lightweighting.

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