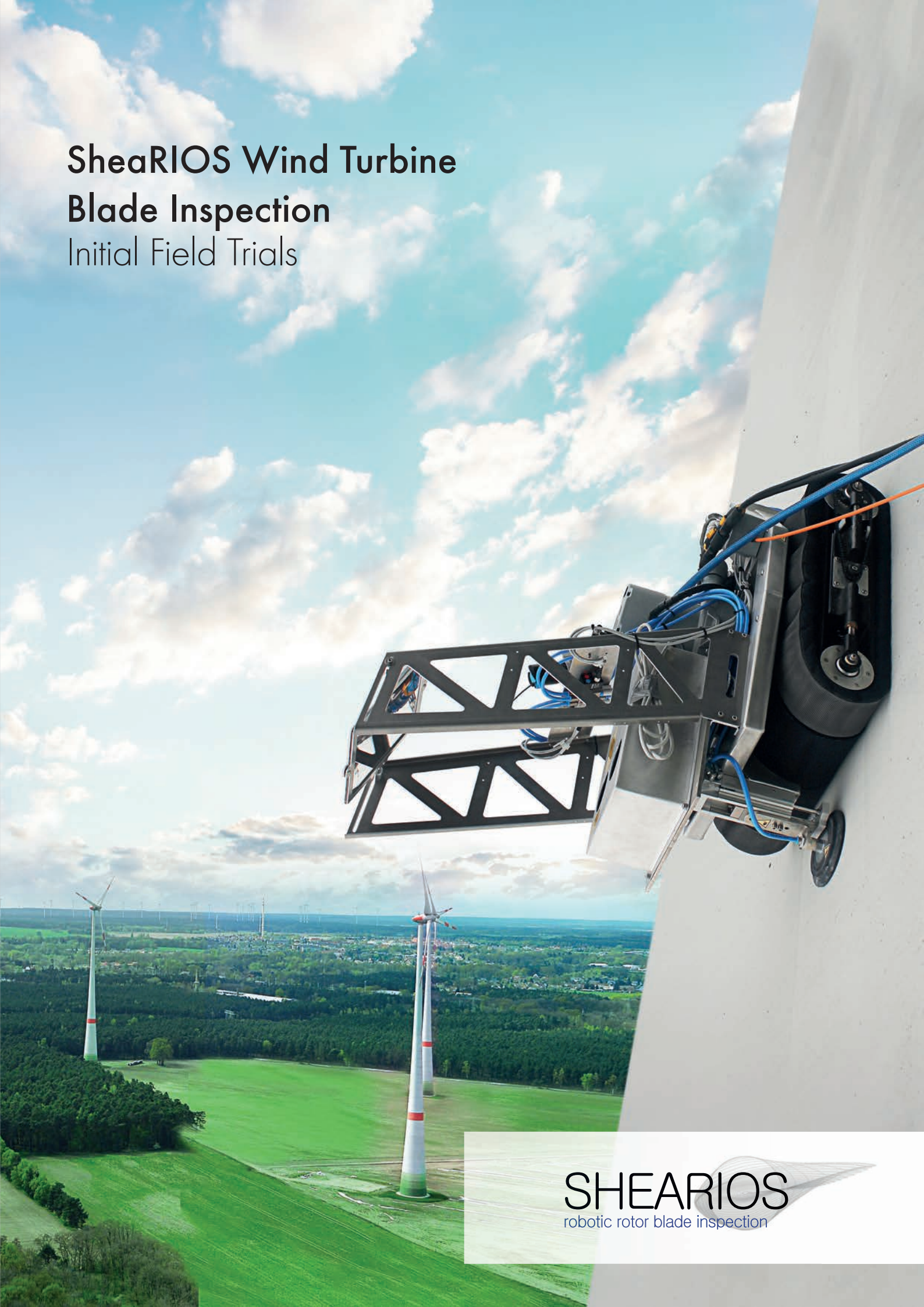
SheaRIOS Wind Turbine Blade Inspection

Initial Field Trials



SHEARIOS

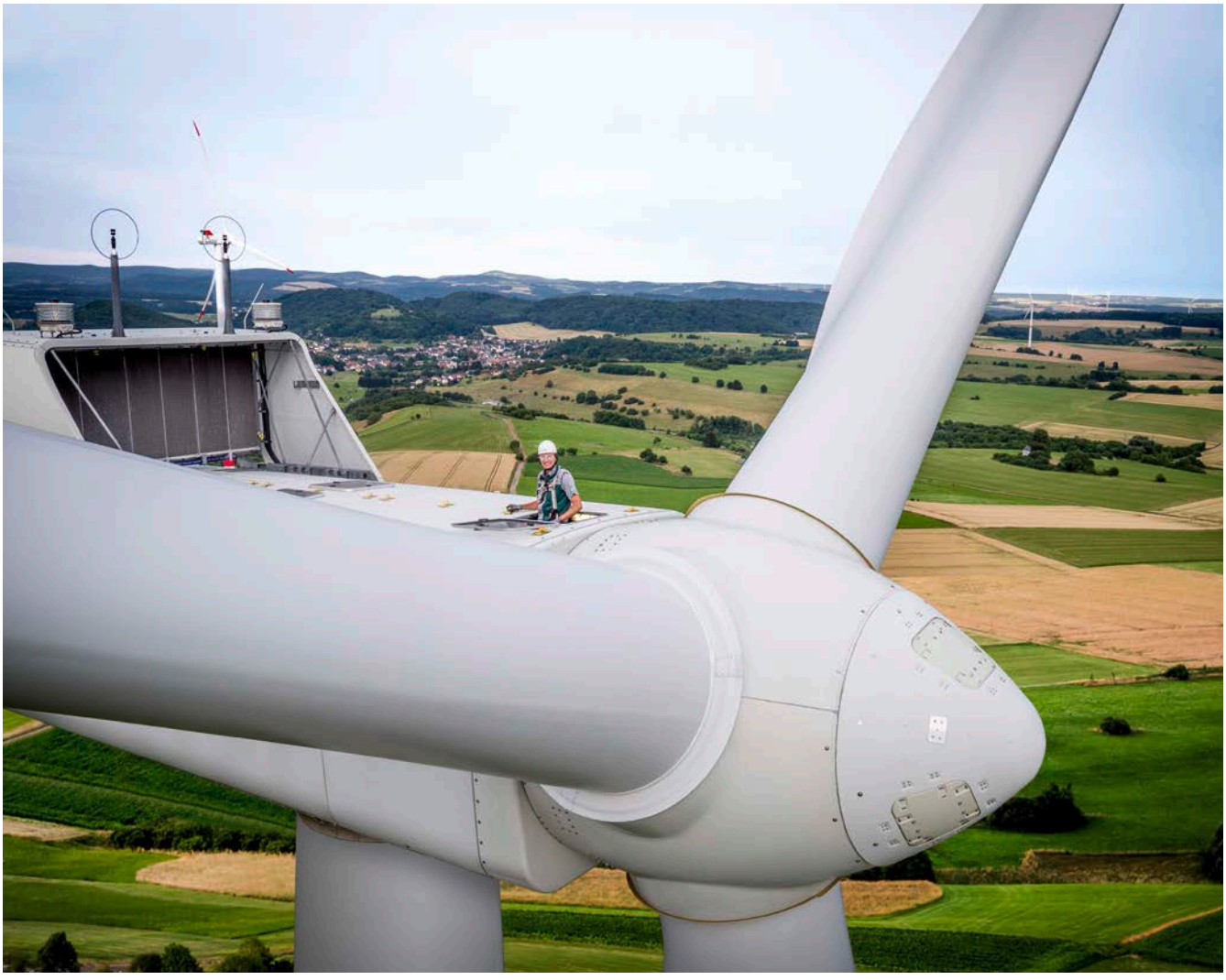
robotic rotor blade inspection

SheaRIOS, the world's first remote-controlled shearographic wind turbine blade (WTB) inspection system capable of safe, fast and accurate assessments on operational blades was field tested at EDF Energy, Hartlepool (UK).

The system comprises four main modules:

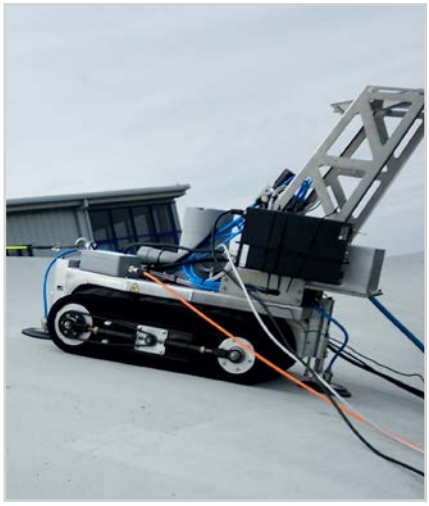
- A robotic climbing vehicle built by IKnowHow (Greece).
- An ICM robotic crawler adapted and integrated by Dekra (Germany).
- A shearography inspection system developed by TWI (UK).
- Control and communication software written by Leitat (Spain).

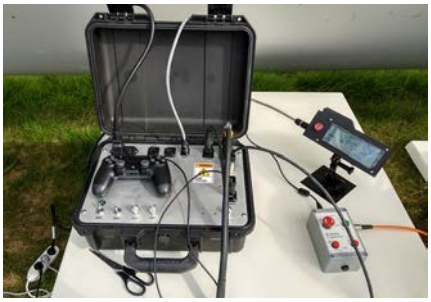
End-user perspective and access to the Teeside wind farm (Hartlepool, UK) was provided by EDF (UK), with system deployment performed by WRS Cathodic (Netherlands).

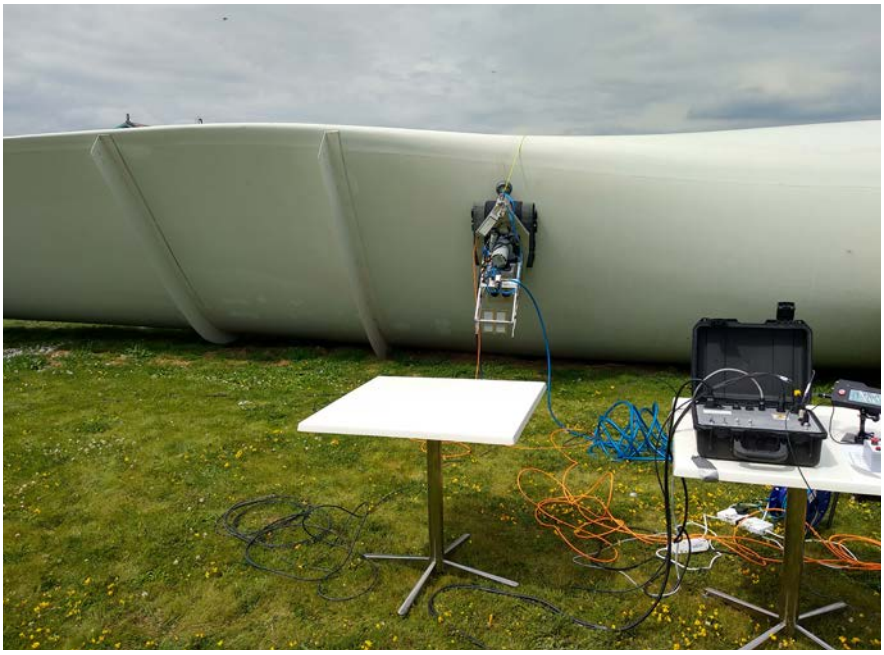


Consortium Partners:

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 780662







Operation

System deployment begins with the robotic climbing vehicle ascending the wind tower to locate the crawler with its shearographic payload onto the WTB.

The crawler navigates the blade on caterpillar tracks, held in position by vacuum, enabling the blade to be inspected without removal from the tower.

During the shearography inspection, a diffused laser is projected onto the surface of the blade and is observed as a speckle pattern that changes with applied stress. Warm air is blown onto the surface of the blade, creating the required stresses and the resultant changes to the speckle pattern are used to identify defects within the structure of the blade.

Operation of the climber, crawler and inspection equipment is controlled at a ground-level base station located at a safe distance from the tower. This significantly reduces the risks associated with WTB inspection, which is normally performed in often hazardous conditions by rope access technicians.

Field Trials

IIn this first round of field trials, to provide ease of access, rapid adaptation of the equipment and enhanced safety, testing was performed with the blade lying on the ground.

The aim of the trials was to assess:

- The performance of the robotic crawler on the complex 3D surface geometry of a WTB.
- The suitability of the vacuum system to maintain intimate consistent contact between the crawler and the WTB.
- The smooth function of the integrated modules.

The performance of the crawler's caterpillar tracks and the vacuum feet exceeded expectation, keeping the crawler securely attached to the blade in an overhang position. Whilst in the overhang, the crawler was able to navigate over the blade's surface to numerous predetermined locations. This demonstrates that the vacuum system has sufficient redundancy to stay attached with additional loading, such as would be expected in windy conditions.

Both of the integrated modules used their own control systems. The trials demonstrated compatibility between these systems and laid the foundations for an integrated user-friendly interface.

A major challenge to the SheaRIOS project was to develop a stable blade crawler with a sufficiently large area of inspection. The novel concept adopted modified the laser light path, allowing the crawler's centre of gravity to be moved closer to the blade, whilst maximising the inspection area. This approach is now protected by patent.

Benefits

In summary, the SheaRIOS inspection system provides the following benefits:

1. In-situ blade inspection.
2. Subsurface defect detection in composite structures.
3. Adaptable multi-payload robotic system.
4. Minimal need for rope access inspection.
5. Total WTB inspection time typically reduced by more than one day.
6. Significant reduction in wind turbine downtime lost revenue.

Next Steps

Comprehensive validation trials are planned for 2021, followed by live demonstrations to the Wind Energy sector.

For further information visit the SheaRIOS website (shearios.com), or email the project team at (e.g. enquiries@shearios.com).

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