ORION

CHALLENGES

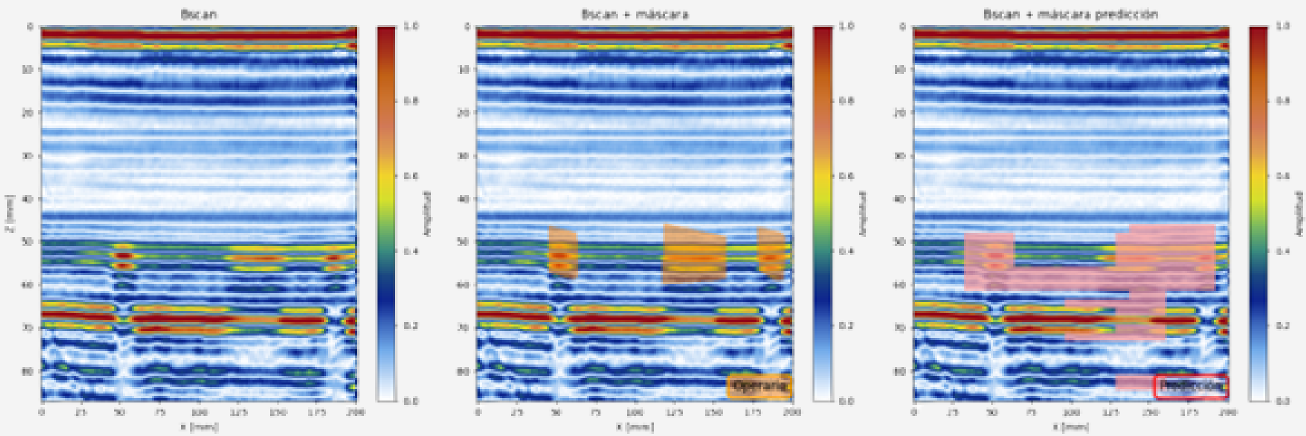
Before the project, our organisation faced significant challenges in the evaluation of **ultrasonic non-destructive testing (UT) data** for large and complex components. Inspection processes relied heavily on manual interpretation by expert operators, which was time-consuming, difficult to scale, and prone to variability between inspectors.

The increasing volume and complexity of inspection data made it **harder to ensure consistent defect detection and traceability of decisions.** Additionally, existing automated solutions lacked transparency and operator trust, limiting their adoption in real industrial environments. There was a clear need for solutions that could improve efficiency and reliability while keeping human expertise at the core of the inspection process.

THE SOLUTION

Within the **ORION Application Experiment**, we developed an **AI-assisted ultrasonic inspection framework** based on a **human-in-the-loop approach**. The solution combines advanced signal processing and machine learning algorithms with an intuitive Human–Machine Interface (HMI).

Operators can visualise ultrasonic data, validate automatically detected defects, manually annotate critical regions, and use this feedback to continuously improve the underlying AI models. This approach ensures robustness, explainability, and acceptance by end users, while enabling progressive automation of inspection tasks.



A representative ultrasonic B-scan obtained during inspection, combined with defect segmentation results.

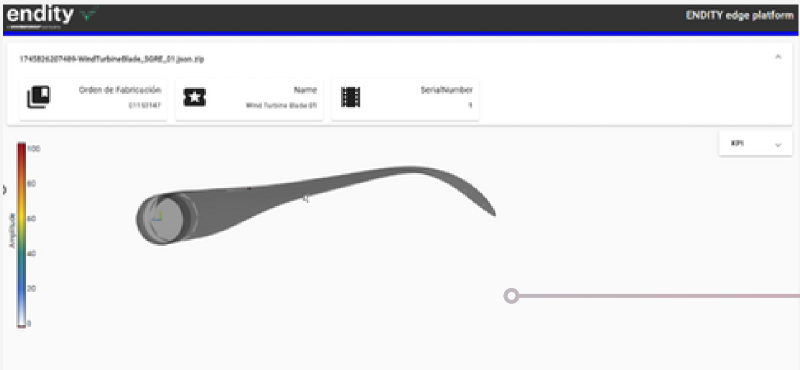
EARASHI is an EU project funded by Horizon Europe under GA 101069994.

RESULTS

The project delivered measurable improvements across **robotics, human factors, and AI performance**. By introducing the IoT hardware module (WP1), **data acquisition** from robotic UT inspections **was reduced from more than 3 hours of manual setup to approximately 1 hour**, representing a **66%** improvement in acquisition efficiency and directly contributing to a **15% increase in overall NDT inspection productivity**.

The integration of automated data synchronization also enabled a **60% reduction in inspection time and cost**, as a single operator can now complete setup, acquisition, and validation in around **1 hour instead of the previous 2 operators and 2.5 hours**, with all data automatically serialized in JSON and no need for post-processing scripts. From a human-centred perspective, HCI Index assessments showed a **40% average improvement in stress-related factors**, confirming a **25% reduction in perceived operator stress** through improved ergonomics, simplified workflows, and co-designed interfaces.

Finally, the AI-based defect detection solution achieved **90% detection accuracy on annotated datasets**, exceeding the targeted **10% improvement in accuracy and reliability** for wind blade component inspection by effectively combining deep learning techniques with operator input.



ORION application interface used during wind turbine blade inspections. It presents a 3D representation of the blade with the precise localisation of detected defects, together with associated KPIs that support decision-making at component level. This visualisation allows operators to quickly assess the inspection status, defect distribution, and inspection performance in an intuitive and industrially relevant manner.

IMPACT

Participation in the EARASHI project has strengthened our **technological positioning** in AI-assisted non-destructive testing. It accelerated the **transfer of research results** into industrially relevant solutions and enhanced our capability to deliver more efficient, reliable, and operator-centred inspection systems to industrial partners.

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