

Workshop – Fatigue life assessment based on structure specific as-build and corrosion data

Date: 15/09/2026

Location: Zwijnaarde, MRC Building, Technologiepark 48

Abstract:

In this joint event of the FIRMEST and PIT project, advances in fatigue life assessment using structure specific data will be presented. By feeding fatigue life models with data about your specific assets, obtained in as-build state and during the structure's lifetime, the expected lifetime of individual structures can be updated considering their specific condition.

The FIRMEST project focuses on characterizing the influence of the as-built condition on fatigue resistance. This includes the actual weld geometry and the integration of global and local geometrical imperfections, such as misalignments and ovality, which are neglected in idealized design models. In-house algorithms (semi-)automatically convert 3D laser scanning data into high-fidelity finite element models to accurately quantify local stresses in joints with irregular weld profiles. The project also implements a single-sensor virtual sensing strategy to reconstruct accurate strain histories at fatigue-critical details and utilizes a dedicated data architecture to maintain a fatigue digital twin for every turbine in a farm. Advanced characterization of long-term monitoring data is utilized to more accurately account for real-world load interaction effects, along with the integration of a non-linear fatigue damage accumulation algorithm.

The PIT project focusses on the development of methods to characterise the risk and extent of pitting corrosion on offshore structures. From 3D scans of corrosion coupons exposed in or at the structure under consideration the amount and geometry of corrosion pits can be quantified as input for corrosion fatigue models. Techniques for continuous monitoring of pitting corrosion based on electrochemical measurement principles are being developed to complement the periodic coupon inspection.

The event will present the main outcomes of both projects. The aim is to outline how the results can be implemented in an industrial context and to obtain feedback on the routes and roadblocks to adoption of the developed tools.

Agenda

9h00: Coffee and registration

9h30: Welcome & workshop rationale *Speakers: Prof. Kris Hectors (UGent) & dr. Jeroen Tacq (Sirris)*

An introduction framing how structural assessment evolves across the lifecycle of an offshore wind turbine—from design and as-built fabrication tolerances (FIRREST) to corrosion state assessment (PIT). The session outlines how moving from generic design curves to asset-specific digital data reduces conservatism and optimizes lifecycle management. Attention will be focussed on those aspects where there is complementarity between the FIRREST and PIT projects.

9h45: Part 1 (FIRREST) | As-built weld geometry and advanced local fatigue assessment, *Speaker: Prof. Kris Hectors (UGent)*

Standardized fatigue assessment methods (such as nominal, hot-spot, and effective notch stress) cannot capture the true geometric irregularity of real-world welded joints. This presentation explores the transition from traditional quality classes to automated scan-to-FEA workflows:

- *Challenges in digital visual testing (D-VT):* An overview of the state-of-the-art in optical 3D scanning for weld inspection, current IIW best-practice guidelines, and the disconnect between ISO 5817 weld quality classes and actual fatigue performance.
- *Non-local fatigue assessment:* Why high-resolution 3D scan meshes require advanced stress averaging models (e.g., implicit gradient approaches) to compute reliable local effective stresses without numerical singularities.
- *Data compression and parameter extraction:* Strategies to compress massive 3D point clouds into critical geometric parameters for integration into database systems while preserving fatigue prediction accuracy.

10h45: Coffee break

11h00: Part 2 (PIT) | Characterization and monitoring of localized pitting corrosion *Speakers: dr. Jeroen Tacq (Sirris); dr. Majid Shamlooei (KULeuven)*

Pitting corrosion creates critical localized stress concentrations that accelerate fatigue crack initiation in offshore environments. This presentation outlines the tools that are being developed to make monitoring of the occurrence of pitting corrosion on carbon steel structures possible:

- *3D Scanning of corrosion coupons:* The use of corrosion coupons as a low-threshold and cost-effective way to monitor localised corrosion will be outlined. Attendees will learn about practical methodologies for deploying corrosion coupons, optimal microscope selection, 3D scanning workflows, algorithmic pit detection and the need to build robust in-house corrosion datasets.
- *Permanent electrochemical sensors:* The technical concept and proof-of-concept testing for a sensor that allows continuous, remote, real-time tracking of pitting

corrosion activity will be presented. The pitting phenomenon will be explained, showing how it generates electrochemical activity, and what a sensor could potentially detect. Pathways and hurdles to the practical implementation of the technology concept, as well as the translation of sensor data into environmental risk indicators and useful decision support, will be discussed.

12h00: Part 3 | Vision towards the future: structured data framework for tracking fatigue-critical details

Speakers: Prof. Wout Weijtjens (VUB), Prof. Kris Hectors (UGent), Dr. Jeroen Tacq (Sirris)

- This presentation explores the implementation of a structured data framework for tracking fatigue-critical details — ranging from original weld geometries to inspection-identified anomalies like pitting corrosion — across the entire lifecycle of offshore wind turbines. Guided by the through-life management principles of IEC-TS 61400-28 and using the OWI-metadatabase structure, developed for fatigue details in FIRMEST, as a baseline template. By shifting from raw datasets of 3D scanned data to curated, standardized metadata, this approach preserves essential domain expertise, extracts critical defect characteristics, and contributes to an efficient through-life management of offshore wind assets.
- To close the morning presentations ahead of the demo's and networking lunch, this final session consolidates the workshop themes into a forward-looking vision of where structure-specific fatigue assessment is heading. The presenters will outline the consortium's roadmap for uniting as-built fabrication metrics with in-service operational degradation within an integrated, dynamic lifetime updating framework. Attendees will see how dense 3D scan data of welded joints and corrosion fields can be effectively compressed into rich, lightweight feature sets that faithfully reconstruct critical stress concentration factors and local gradients to obtain fast and accurate corrosion-fatigue life estimations.

12h45 – 14h00: Interactive demonstrations & networking lunch

Over lunch, an open exhibition and networking session will take place where participants can interact directly with the project partners and further explore how the project outcomes may be implemented in practice:

- Live 3D weld scanning (FIRMEST): Live demonstration of 3D optical scanning on welded specimens.
- Corrosion coupon showcase (PIT): Display of coupons from different offshore exposure zones, how they are installed today and their high-resolution 3D optical surface models. A preliminary version of corrosion-fatigue life analysis dashboard for rapid visualization of the effect of pitting on fatigue life will also be shown
- Corrosion sensor concept (PIT): Showcasing sensor proof-of-concept data and sensor concept proposal, allowing to discuss the pathway for companies to engineer a real sensor product.