WATEREYE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 851207

O&M Tools Integrating Accurate Structural Health in Offshore Energy

Welcome

Dr. Ainhoa Cortés
WATEREYE Project Coordinator

Dear reader,

In this second newsletter, you will find information about the latest activities that have been carried out and the results generated so far within the WATEREYE project. As part of the meetings plan, the second Engineering Workshop took place over three successive days on 27-29 October, in which the consortium partners presented their most relevant outcomes regarding the US (ultrasound) corrosion measurements, and the status of the 3D visualization, prognostics and forecast tools, which will be further developed. On the events section, you will find information about the coming events and conferences in which the WATEREYE project partners will participate. Last, but not least, on our partners' corner you will know more about Delft Dynamics and its involvement in the WATEREYE project.

On behalf of the WATEREYE project consortium, I would like to wish you a Merry Christmas and all the best for the coming year.

Ainhoa Cortés.

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About WATEREYE

The WATEREYE integral solution will allow Wind Farm Operators to accurately predict the need for future operations & maintenance (O&M) to reduce its costs, which can represent up to 30% of the Levelised Cost of Energy (LCOE) (an estimated LCOE of 70€/MWh in 2030), and to increase the annual energy production from the offshore wind thanks to an accurate structural health monitoring and control of the Offshore Wind Farms.

For this purpose:

1. WATEREYE aims to develop high-accuracy, fast-response, and non-invasive ultrasound smart sensors to detect and estimate corrosion levels by analysing wall thickness, which will be integrated into a high-precision indoor "drone-based mobile platform" inspection system capable of monitoring the entire critical area.
2. Design a robust wireless communication system and a custom protocol that will prevent data losses or corruption even in a harsh environment.
3. Collect, store, and provide efficient access layers for the wind turbine data to ensure optimal understanding of structural health.
4. Develop accurate mathematical corrosion models for offshore wind turbine structures to characterize the corrosion phenomena in the wind turbine tower.
5. Develop condition-based maintenance tools for fault diagnosis; corrosion prognosis algorithms; decision support to define predictive O&M; and fault-tolerant control of offshore wind structures.
6. Develop control algorithms for adaptive O&M strategies of individual wind turbine and the overall plant. The WATEREYE monitoring system will determine the condition of the structures. This information, together with O&M tasks, will minimise the need for human inspection, vessel transfer, and optimising onshore logistics.

Visit us at www.watereye-project.eu to extend this information

Download here our leaflet to get more details about WATEREYE concept and methodology

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Meet the WATEREYE Team

*Click on logos to access the partner's webpage watereye

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Follow us and share it

We would like to encourage you to follow us on our [website](), [Twitter]() or [LinkedIn]() as well as to tag @watereyeproject in your tweets to circulate news, publications or events on our Twitter feed. In the same way, we encourage you to use @WATEREYE PROJECT in your LinkedIn public actions regarded to WATEREYE.

WATEREYE News

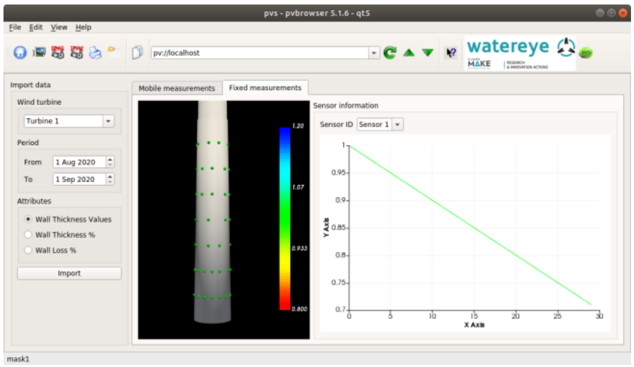
Second Engineering Workshop – Online event - 27th, 28th and 29th October

Last 27th, 28th and 29th October, the second Engineering Workshop led by CEIT was held online due to the Covid-19 pandemic. Throughout these three successive days, the participants were able to join a virtual tour through Delft Dynamics and TU Delft facilities.

Furthermore, the first outcomes from WP2 were presented, such as Delft Dynamics drone adaptations and the latest improvements on the visualization tool developed by Flanders Make with contributions from SINTEF Industry on the corrosion model within WP3.

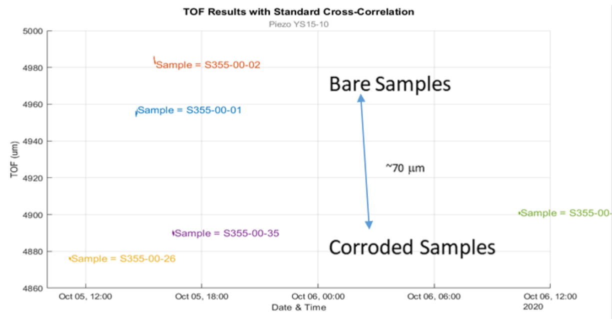
Next activities will be focused on prognosis and fault-tolerant control.

Find more information about the Second Engineering workshop [HERE]().



CEIT performing corrosion measurements with the SINTEF-I samples (testbed)

Ceit has been performing US (ultrasound) measurements using their own US testbed on the samples produced by SINTEF-I with the aim of designing a low-cost, low-power and accurate solution for the detection of the corrosion state (loss of thickness) of the wall of the tower structures.



As can be seen, Ceit's system is capable of estimating the Time-Of-Flight (TOF) which is proportional to the thickness of the sample. Hence, Ceit's system detects the loss of thickness in this case comparing the 1-month bare steel corroded samples with bare steel non-corroded samples. Ceit continues working on the measurements applying different types of piezoelectric sensors and other kind of signal processing algorithms over the set of samples produced by SINTEF-I including coated samples with standard coatings usually applied to offshore wind structures.

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Another important aim for the WATEREYE project is to evaluate and compare the corrosion evolution of some samples corroded through accelerated lab tests at SINTEF-I with the natural corrosion evolution of identical samples from the field tests at the PLOCAN's offshore platform.

First field tests at PLOCAN

As WP5 leader, PLOCAN has been conducting the first of four field tests where 42 steel samples are being tested under real conditions at PLOCAN's Offshore Platform.

These activities are being carried out in collaboration with CEIT and SINTEF-I to validate the US smart corrosion sensors and the corrosion models.

Delft Dynamics working on the Drone Docking Station & the Mobile Platform

Delft Dynamics has been working on the development of the Drone Docking Station and the Mobile Platform for the WATEREYE project. So far, they achieved to let a tethered drone, similar to the Mobile Platform, take-off and land on a relatively small, 1.2 meter square platform. They also made a successful test flight with a drone powered by a tether cable. These results are promising for the application on the Drone Docking Station.

Since the Mobile Platform is going to fly in an indoor environment, its rotors need to be protected against collisions. For that reason, they have developed a rotor guard made from lightweight aluminium tubes which is showing promising results in terms of robustness and applicability.

For the Indoor Positioning System, Delft Dynamics has tested a couple of SLAM-Sensors such as a tracking cam and a Lidar laser system. The tracking cam can provide data fast enough to use it for stable control of the mobile platform. Delft Dynamics has made preliminary design concepts for the Sensor Placement System for the wall thickness measurements. These concepts will be further developed in the coming period.

Flanders Make progressing on 3D visualization tool and prognosis code framework

A first version of the 3D visualization tool is now available. Currently, the tool allows to import a CAD model of a wind turbine and fictional measurements from fixed sensors which are visualized both in 3D on the wind turbine CAD model and 2D as an XY plot over time representing the evolution of the

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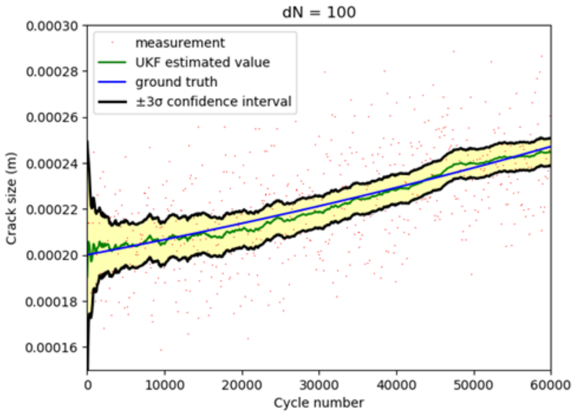
corrosion state of a selected location on the wind turbine structure over time. In the next versions the functionality of the tool will be further extended and real data will be imported.

Flanders Make has developed an initial prognosis code framework as part of one of its tasks to design and implement corrosion diagnosis and corrosion prognosis algorithms for offshore wind turbines. The framework has been verified with the crack fatigue prognostics as shown in the figure below and is flexible to allow different types of corrosion models as an input.



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Events

EERA DeepWind 2021 – Offshore Wind R&D Digital Conference – 13-15 January, Trondheim, Norway

SINTEF-I will be presenting the abstract: "Corrosion and corrosion monitoring of structural steel in offshore wind turbines", in collaboration with **CEIT**. The aim is to present the WATEREYE project, its objectives, the methodology to be followed and its results to date.

More info HERE.

Wind Europe Electric City 2021 - 27-29 April Copenhagen

Wind EUROPE ELECTRIC CITY 2021 27-29 APRIL COPENHAGEN

CEIT will participate at Wind Europe Electric City 2021, which will take place on April 2021 at Copenhagen. CEIT's aim is to demonstrate its capability of measuring the Time-Of-Flight (TOF) using its US (ultrasound) testbed on different type of samples. In April, CEIT will show the US miniaturized solution. In any case, the US testbed allows us to send the US measurements done to the cloud with the aim of plotting the historical data from previous measurements through the web application designed by SWC (Semantic Web Company).

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"Electric City" is a new onshore and offshore wind event, with participants from wind and beyond – heavy industry, mobility, district and domestic heating, storage, hybrids, hydrogen and many more – to join the conversation on how we build a clean economy.

More info HERE.

Wind Energy Science Conference (WESC) – 25-28 May 2021 – Hannover, Germany

CEIT has submitted the abstract: "Smart corrosion monitoring system to improve the O&M strategies in offshore wind farms" and **Flanders Make** has submitted an abstract entitled "Towards a Digital Twin for Corrosion Monitoring of Offshore Wind Turbine Structures". This conference allows scientists in the field of wind energy to present their latest findings and meet across traditional scientific borders, covering all scientific topics in wind energy.

Due to the unpredictable development of the COVID-19 pandemic, WESC 2021 will be organised as a web conference. The call for abstracts has been extended until January 17, 2021.

More info HERE.

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Partner's corner

Delft Dynamics

Delft Dynamics B.V. is an innovative, high-tech company founded in The Netherlands in 2006. It is specialized in developing and building small unmanned helicopters and multicopters (drones) that can be used as stable, easy to control sensor platforms. This is accomplished by smartly combining computer and sensor technology.

Illustration 1: RH3 'Swift' on open sea

Delft Dynamics (DD) has been providing UAS (Unmanned Aircraft System) engineering services to third parties for years (inspection of e.g. transmission towers and flare-tips) and has developed and manufactured several types of robot helicopters (RH2 'Stern', RH3 'Swift' and RH4 'Spyder'). We have developed systems for (Dutch) Defence and police and are also involved in many national and international RD&T projects together with well-known knowledge institutes and universities. Below are some of the projects and products we are currently working on.

NEREUS/RH3

NEREUS is a naval drone project with the goal to increase maritime situational awareness on ships by using a relatively small space for starting and landing. A combination of an automated take-off, flight, and landing with a lightweight drone, and seawater resistant sensors on board gives a big operational advantage.

The wish for increased situational awareness is important for search, intrusion, and interception operations, to act faster and more flexible in fast differing situations and circumstances.

A Delft Dynamics RH3 'Swift' robot helicopter is used for project NEREUS. It is a compact unmanned helicopter for long endurance and long-distance flights, ideal for missions on open waters.

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DroneCatcher

DroneCatcher uses a multicopter (RH4 'Spyder') armed with a net. It can safely remove illicit drones from the air. After detection by, for example, radar, vision, or an acoustic system, DroneCatcher can quickly approach hovering or moving treats. With the use of multiple onboard sensors, the net gun can be locked on the target. After locking, the illicit drone will swiftly be caught by shooting a net. After the catch, DroneCatcher can carry the captured drone on a cable to a harmless place and release it there. A heavier drone that is caught but cannot be carried, will be dropped with a parachute to ensure a soft landing.

Illustration 2: DroneCatcher

U-Drone

In 2018 Delft Dynamics won the NATO Innovation in Defence Competition "The Underground". The goal of this competition was to explore underground structures like caves, tunnels, and buildings. These are operations with high risk. The use of a drone reduces the risk for the pilot immensely.

The 'U' in U-Drone stands for Underground, Unlimited, Unjammable, User-friendly, and Unearthing. This drone is designed to explore underground structures. Usually, drones are not able to maneuver in the underground territory due to the loss of radio signals in such an environment. The U-Drone uses a cable to communicate with the pilot, this makes the drone also insensitive to loss of radio signals and jamming. The U-Drone technology demonstrator has a proven flight distance of 100 meters and counting. During a flight, U-Drone makes a real-time 3D map of the environment using lightweight SLAM sensors.

WATEREYE

Delft Dynamics will adapt a drone (RH4 'Spyder') to be used as a flexible mobile platform for the WATEREYE project. The drone will take-off from a Drone Docking Station placed inside an offshore wind turbine. After take-off, the drone will fly to one or more given locations provided by the WATEREYE computer and positions a corrosion sensor with high precision on the wall of the atmospheric zone in the wind turbine. These measurements contribute to give insight into the structural health of the wind turbine. This project is a great opportunity to apply and enhance our knowledge about the naval flight, automated high precision operations, and indoor navigation in a challenging offshore environment.