watereye
RESEARCH
& INNOVATION ACTIONS

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,

The WATEREYE project is now immersed on the *Integration and Validation* phase, which combines WP2, WP3 and WP4 developments into an integral sensing, monitoring, diagnosis, prognosis, decision support and smart control solution, which have already been validated at lab-scale and will soon be validated in a relevant environment.

In this fifth newsletter, the integration and validation sessions conducted in Delft and Belgium will be further presented, in which the wireless communications, US measurements, mobile platform, and other elements were tested obtaining satisfactory results. A second validation in Belgium is scheduled, to refine results and implement improvements towards the validation in a real environment at the PLOCAN offshore platform in Gran Canaria (Spain).

In terms of Communication & Dissemination, the 1st WATEREYE Dissemination Workshop was finally held last February, gathering a good representation of key stakeholders in which the partners presented their last results to the audience. Moreover, the project has been present at WindEurope 2022 in Bilbao and EERA DeepWind 2022.

This period has also been very productive in terms of scientific content generation, highlighting three Open Access publications from CEIT and FMAKE.

Thank you for your interest in the WATEREYE project, enjoy the reading!

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

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Follow us and share it

We would like to encourage you to follow us on our website, Twitter , LinkedIn and YouTube official channel 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

Third physical integration conducted

On March 16th-18th the third physical session was conducted in Delft, with the aim to continue testing the ultrasound meaurements done by the mobile sensor node integrated into the drone. We improved the wireless network management to stop the ranging process automatically when the ultrasound probe is positioned and ready to perform the measurements and send them to the WATEREYE Computer (WEC). On top of that, the system composed by 8 Ultra-Wide Band (UWB) anchors, the mobile sensor node into the drone and the WEC was tested taking measurements dynamically when the drone was flying.

The US sensor was placed on the position of the lower rubber stopper, therefore allowing more pressure on the sensor. This, combined with the increased sample rate of the Ultrasound Ultra-Wide Band Device (UUD) provided good results. As a summary:

- The ranging estimations between the UWB anchors and the mobile node were used for the altitude estimation of the drone.
- There were not interferences between the UWB links and the wireless communications used to pilot the drone.
- The ultrasound measurements were good even in vertical position and with the presence of vibrations when the ultrasound probe was placed on the characterized samples.

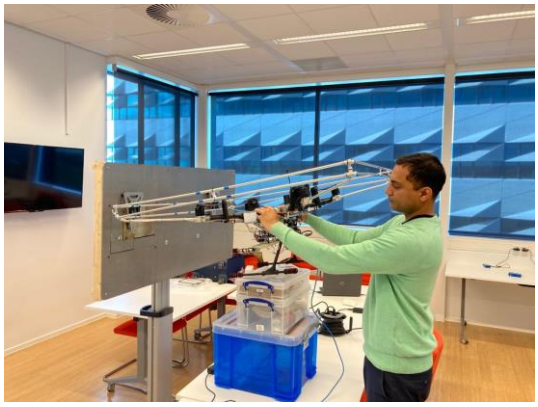

Figure 1. Ultrasound static measurements

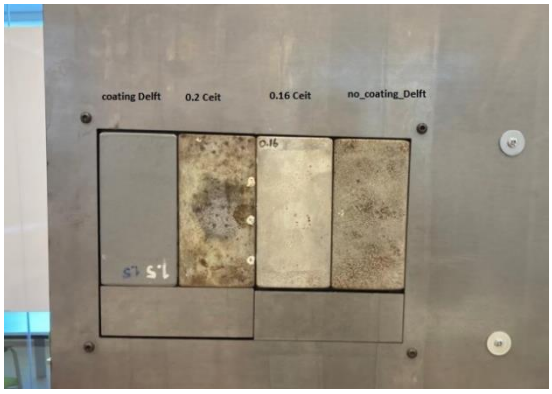

Figure 2. Bare steel samples placed in the plate for the US measurements

Regarding the validation of the UUD and the Mobile Platform, Delft Dynamics was able to solve hardware and software timing issues on the serial protocol between the UUD and the mobile platform.

Also, the most optimal anchor positions were selected for the most accurate altitude estimations from the UWB range measurements. The resulting altitude was verified during the

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validation compared to a laser altitude measurement device on the drone.

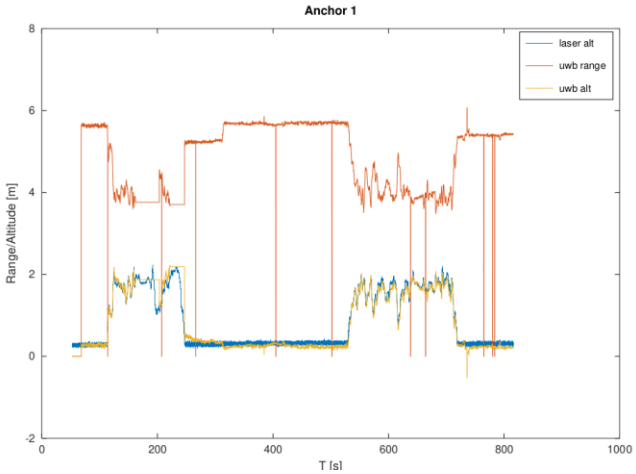

Figure 3. Altitude estimations for Anchor 1

First integration and validation session in Sint-Truiden, Belgium

On March 31st, a two day integration session was held at DronePort in Belgium. The goal of this integration was to perform an intermediate validation of the work done in the WATEREYE project.

CEIT and Delft Dynamics conducted the tests to validate the wireless communications, the drone and US probe positioning, and the thickness estimations using the ultrasound device integrated into the drone. These tests were conducted inside a mock up of a wind turbine tower consisting out of a steel structure of 32 panels which can easily be built-up and dismantled. A camera was mounted to follow the activities from outside safely.

Figure 4. Validation set-up at DronePort

Good results were obtained with the drone flying. The thickness estimations were received wirelessly by the WEC and the drone was able to estimate the US probe positioning correctly.

During the validation it was found that the Indoor Positioning System (IPS) did not perform optimal for the heading calculation of the drone. Therefore, the heading result of the algorithm had an offset error. An optimized model for heading calculations will be tested during a second validation in Belgium.

All actions were logged to prepare for a smooth final demonstration at the offshore platform of PLOCAN, in Gran Canaria (Spain).

In terms of communication activities, a dissemination video was recorded during the validation session.

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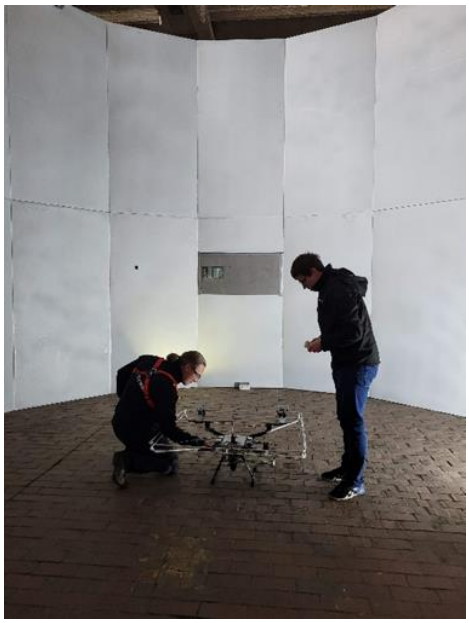

Figure 5. DD team configuring the drone before flying

1st Dissemination Workshop, 4th February 2022 - online

Last 4th February, the WATEREYE project organised its 1st Dissemination Workshop. The opening session and welcome was provided by Andreas Momber from Muelhan AG. Throughout the event, the latest results were presented by the project partners. The workshop gathered representatives from industry, academia, and research intitutions.

Figure 6. 1st WATEREYE Dissemination Workshop

For more information, the event recording is available here.

WATEREYE project present at WindEurope 2022 in Bilbao

The WATEREYE project was present at the WindEurope Annual Event, which took place from 5 to 7 April 2022 in Bilbao (Spain). The project coordinator, Ainhoa Cortés from CEIT had the chance to present the WATEREYE project to those interested in learning more about the project and its results.

There, the project coordinator was interviewed by the Energy Agency of the Basque Government, where she presented the main research areas of CEIT and their role within the WATEREYE project.

Watch the full interview here.

Figure 7. WATEREYE Project Coordinator in WindEurope 2022

Furthermore, our colleague Upeksha Chathurani from CEIT presented a poster on "Ultrasound Testbed as a Design Methodology of Corrosion Smart Monitoring System In Offshore Wind".

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Figure 8. CEIT poster in WindEurope 2022

FMAKE and SINTEF-E presented at EERA DeepWind on 19th-21st January 2022

FMAKE and SINTEF-I delivered some presentations at the ERA DeepWind'22 event:

1. Corrosion Detection and Prognostics for Offshore Wind-Turbine Structures using Switching Kalman Filtering.
2. Decision Support Tool for Predictive Maintenance of Offshore Wind Turbine Structures.
3. Joint optimization of preventive and condition-based maintenance for offshore wind farms.

Figure 9. WATEREYE partners presentations at EERA DeepWind 2022

Open Access articles published

Three open access articles have been published by the project partners CEIT and FMAKE:

1) U.Chathurani, A. Cortés, A. Irizar. *Ultrasound-Based Smart Corrosion Monitoring System for Offshore Wind Turbines.* Article available here.
2) A. Guisasola, A. Cortés, J. Cejudo, A. da Silva, M. Losada, P. Bustamante. *Reliable and Low-Power Communications System Based on IR-UWB for Offshore Wind Turbines.* Article available here.
3) J. Verhelst, I. Coudron, A. P. Ompusunggu. *SCADA-Compatible and Scaleable Visualization Tool for Corrosion Monitoring of Offshore Wind Turbine Structures.* Article available here.

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Events

Torque 2022, 1-3 June 2022, Delft. The Netherlands

Biennial scientific conference 'The Science of Making Torque from Wind' (TORQUE). The 9th edition, TORQUE 2022 will be hosted by the TU Delft Wind Energy Institute (DUWIND) and held from 1-3 June 2022.

More info: https://www.torque2022.eu/

DronePort Connect sessions, 31 May 2022, Sint-Truiden. Belgium

During the DronePort Connect session, innovative energy and drone companies learn which drone applications are available today to inspect energy infrastructure faster, safer and cheaper. This DronePort Connect session targets companies in the energy landscape in Flanders. A series of keynotes, use cases and business pitches will be presented from companies working with products and services around drone applications. The concept of WATEREYE will be presented during the pitches. There is an opportunity foreseen to network at the end of the event. The session is in Dutch.

More info: https://droneport.eu/connect-energie/

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Partner's corner

SINTEF Energy Research

SINTEF Energy Research (https://www.sintef.no/en/sintef-energy/) is an institute for applied research dedicated to create innovative energy solutions. We offer cutting-edge knowledge in Norway and internationally based on research that provides for our clients added-value solutions and services. SINTEF Energy Research is part of the SINTEF Group, which is one of Europe's largest independent contract research organisations. SINTEF is an independent, not-for-profit organisation. None of its owners receive any form of dividend. Profits are invested in scientific equipment, skills and expertise.

The Energy Systems department is heavily involved in different analyses and projects related to power electronics, power systems, reliability, with a strong track record on research for offshore wind power, especially operation and maintenance, grid connection and controls; and a high expertise in the operation and control of offshore wind power plants, with particular experience on coupled electromechanical systems. SINTEF Energy Research is heading NorthWind (https://www.northwindresearch.no/), a Norwegian Centre for Environment-friendly Energy Research.

In WATEREYE, SINTEF Energy Research leads work package 4 "Wind farm control and management tools". Recent other projects on wind farm control include H2020 TotalControl and H2020 FarmConners where SINTEF Energy Research was also a work package leader.

SINTEF Energy Research's work in WATEREYE is on probabilistic wind farm control which considers uncertainties that are present in the controlled system. Moreover, SINTEF Energy Research developed an optimization strategy that schedules predictive and condition-based maintenance tasks based on the monitored condition, expected power production and weather forecast. Now, the last step is to combine the probabilistic wind farm control with the maintenance scheduling.