WORLD CLASS MAINTENANCE

Automated Inspection & Repair of Turbine Blades

Towards Zero downtime and Zero on-site maintenance

smart industry

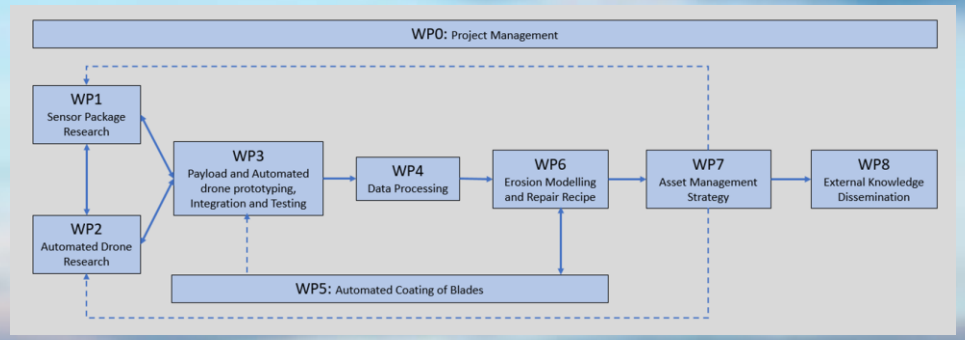
Field lab ZEPHYROS

AIRTuB project goal

Automated Inspection & Repair of Turbine Blades

Prove that more advanced automated sensor - and coating systems can enhance inspection and repair operations around offshore wind parks, in order to:

- Increase AEP
- Decrease the cost of O&M



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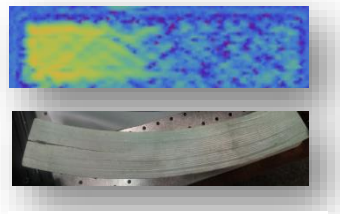
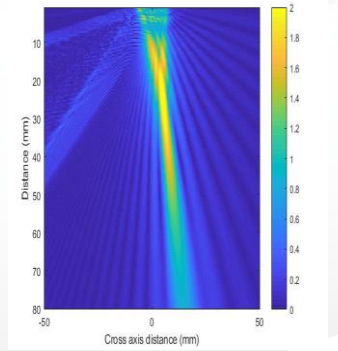
Goal: Develop and test a sensor package able to inspect:

- LEE of offshore wind turbine blades remotely and if possible, while the blades are turning (using 3D mapping of the surface)
- Structural damage of the blades, remotely if possible (using radar and/or thermographics) and in-contact (using ultrasonic)

Activities

- State-of-the-art study on blade damages
- State-of-the-art study on sensors
- Sensor package development
  - ➢ Test and comparison of different inspection methods
  - ➢ Architecture of the sensor package + interfacing with the drone
  - ➢ Offshore test for external –, lab test for internal damage inspection
  - ➢ Investigate working principles with a lab-prototype





WP 1: Sensor package research

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Hanzehogeschool Groningen University of Applied Sciences

Dutch Terahertz Space Quality Inspection

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TU Delft

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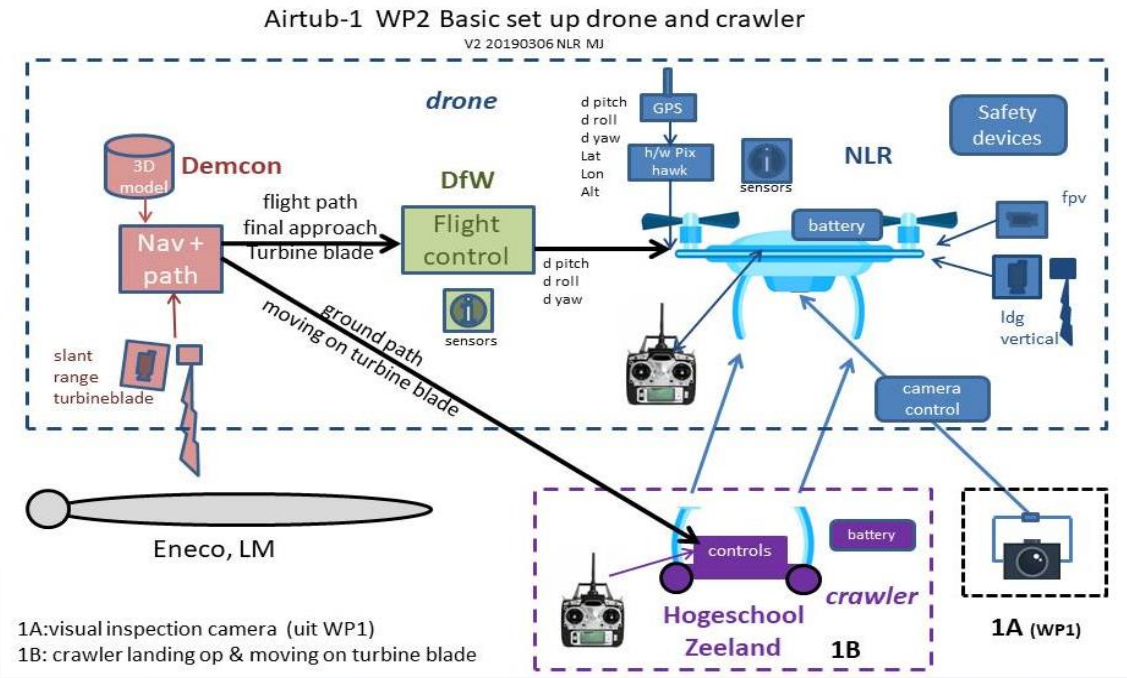
WP 2: Automated Drone Research

Goal: Investigate the drone and crawler concept including payload integration and it's working principles on a lab prototype

Activities:

- Definition use cases
- Concept design
- Experimental setup / lab testing
- Onshore drone testing



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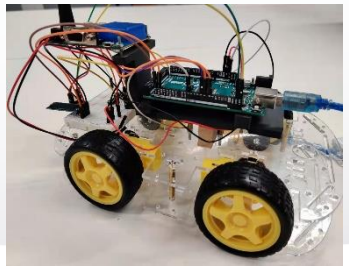
Goal: The development of the drone and crawler concept including payload integration into a fully functional and tested prototype

Activities

- Payload prototyping and testing
  - Camera sensor module
  - Crawler module
- Drone prototyping and testing
- Integration and testing
- Indoor testing, onshore testing
- Offshore testing & data collection



WP 3:
Drone prototyping integration and testing

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WP 4: Data processing

Goal: Ensuring the collected data is accurate and sufficient for use in WP 6 and 7

Activities

- Data Acquisition:
  - Existing performance and inspection data from Amalia Windfarm
  - New data on LEE collected with drone
- Cleaning
- Enrichment
- Storage of cleaned and validated data sets

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WP 5:
Automated coating of blades

qlayers

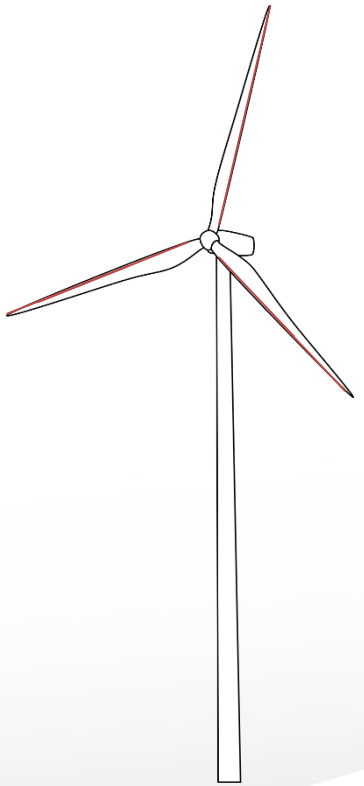
LM WIND POWER
a GE Renewable Energy business

holland hogeschool

Goal: Lab prototype development and testing of an automated coating system that applies a smooth LE coating in production

Activities

- Lab-prototype of a printing head, including UV-curing (Qlayers)
- Lab-prototype of pre-treatment system in production (Qlayers)
- Wind tunnel tests with a blade with printed LE coating for effects on aerodynamic performance (LM)



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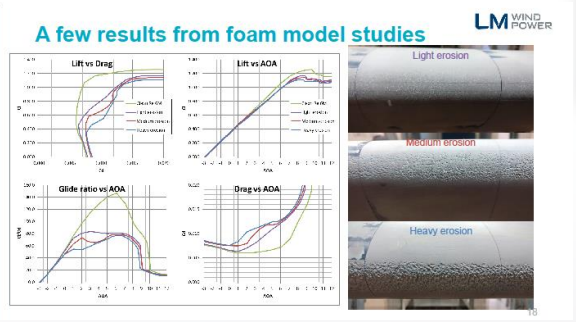
WP 6: Erosion modelling and repair recipe

Goal: Model and validate the aerodynamic effect of erosion so that loss from erosion can be balanced against the costs of erosion repairs

Activities

- Modelling of erosion effects and AEP loss
  - Assessment through an advanced CFD tool
  - Validation of tool with wind tunnel measurements
  - Calibration of a computational efficient airfoil code, RFOIL with CFD results to reduce calculational times
- Classification of erosion and damage repair recipe
  - Classify arbitrary erosion into different categories
  - Relate available data to categories, preferably using prediction or classification models



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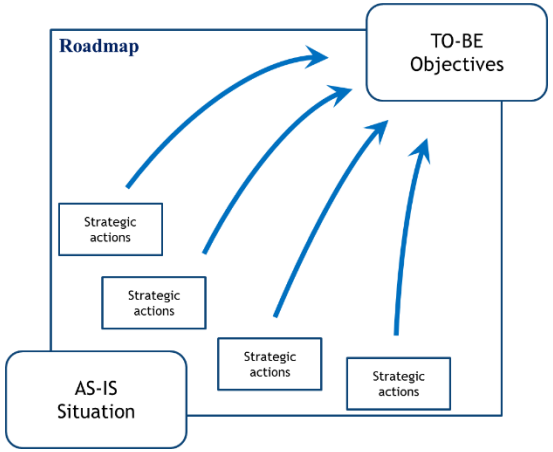
WP 7: Asset management strategy

Goal: Business case of deployment of proposed new asset management strategy

Activities

- Define business goals and baseline definition
- Development of two new strategy scenarios, based on:
  - Cost price analysis of the maintenance of the blades
  - The results of the other work packages
- Comparison analysis and business case of the two innovative strategies
- Create predictive maintenance performance indicators integrated in an existing dashboard tool



Zero Downtime & Zero On-site Maintenance