

Autonomous aerial radiography inspections of offshore wind turbine blades

Publieke samenvatting / Public summary

Aanleiding

Offshore wind turbine blades are regularly inspected for damage during the year as the process of replacing wind turbine blades is a very expensive and time-consuming maintenance activity. Approximately 3 - 4% of wind turbine blades have to be replaced annually because of internal material defects.¹ Early damage detection and repair can prevent minor damages from becoming so severe that wind turbine blades need to be replaced. Current inspections are visual inspections that can detect damages visible from the outside, such as small cracks or edge erosion as well as non destructive testing (NDT) that is able to detect internal structural faults. Visual inspections are already being replaced by cheaper and safer drone based solutions, however NDT inspections still have to be done manually using rope tethered technicians as drone based NDT techniques suitable for wind turbine blades are not on the market. This brings us to the central problem addressed in this project: there is currently no cheap NDT inspection method on the market which wind farm operators can use to accurately detect internal faults.

Doelstelling

The aim of this project is to develop, test and validate an autonomous unmanned inspection system that accurately detects internal structural defects in wind turbine blades (e.g. delamination, cracks, out of plane waves and debonding) using a non destructive testing (NDT) technique called aerial radiography. The use of two drones, one

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carrying an X-ray source and the other a X-ray receiver coupled with highly accurate autopiloting and stabilization systems will make aerial radiography possible. With the use of this new technique, larger damages (and costs) will be prevented and accurate predictive maintenance is possible. In addition, the proposed system works autonomously reducing manual labor and inspection costs significantly.

Korte omschrijving

1. Robotic Navigation Planning system for Radiography Automation. 2. Computer vision and deep learning based system for autonomous navigation. 3. Autonomous flight control software. This software executes the navigation plan (WP1) using the highly accurate navigation capabilities developed in WP2 4. Secure communication system. Ensures safe communication between the two drones and operators 5. Radiography image post processing and asset defect detection. In this WP AI software is trained to detect various defects that can occur in the structure of wind turbine blades. 6. Drone hardware and motion control alignment system. In this WP a heavy duty drone and a stabilization system will be developed. These will ensure a stable platform for the radiography equipment (source & receiver). 7. System integration and interfacing software development. In this WP all the components will be made to work in conjunction with one another. 8. Virtual and real environment system testing. The system will be tested on a test bench, indoors, at an onshore windfarm and finally at a near shore wind farm for testing and validation.

Resultaat

This project will result in a) the ability to conduct drone based radiographic inspection on wind turbine blades, b) a fully functional and tested autonomous dual drone system for NDT WTB inspection ready for demonstration at offshore windfarms and c) SDE++ cost reduction and CO2-emission savings.

Furthermore:

- NDT inspection costs are reduced significantly and thus O&M costs for wind farm operators decrease as well;
- The dual drone

system reduces inspection time from 7 hours to approx. 54 minutes, at least a 87% reduction; • The data collected on the internal material defects allow O&M companies to make better decisions for maintenance and repair actions. In the end, the application of the proposed innovation results in a SDE++ cost reduction of €0,6 / MWh, making €45,0 / MWh the new base value for offshore wind energy exploitation. In addition, a CO2 emission reduction of 386.1 kton is possible as the saved SDE++ money can be spend on other techniques.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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