

Data-driven Identification of Structural Degradation of Offshore Wind Turbines

A support to operation and maintenance strategies to reduce the life-cycle costs

Background

Existing structures including Offshore Wind Turbines (OWTs) deteriorate due to the inherent ageing of materials combined with wear-and-tear from operation and severe environmental conditions.

Over the recent years, the offshore wind market has grown rapidly due to technological improvements in the field and demand for green energy. The production from a single wind turbine has increased more than five times over the last two decades and wind farms are being located at increasingly remote locations. Thus, OWT downtime can mean a significant loss in earnings for the Wind Farm operators. This downtime may be reduced by improving knowledge of the performance of the structure.

Due to a decrease in cost and higher reliability, sensors are increasingly being used for collecting data concerning the actual loading (wave, wind, temperature, and operation) and responses from structures (stresses, accelerations). This has put forward an alternative paradigm for assessing and predicting structural performance based on measurements, creating the field of Structural Health Monitoring (SHM) which can be used to provide information about the performance and state of the structure.

The project objectives

The objective of the present PhD project is to further develop state-of-the-art methods within SHM for OWTs to bridge the gap between the practical application and the state of the art approaches.

During this PhD project, long term monitoring of test specimens at DTU test facilities will be the basis for developing and testing SHM methods.

The success criteria for the project are:

- Establishment of a data-driven method capable of detecting and localizing structural degradation in an OWT structure exposed to environmental and operational conditions, by utilizing methods such as Operational Modal Analysis (OMA), Finite Element (FE) and Machine learning techniques.
- Establishment of an SHM System that enables distinguishing between different degradation mechanisms (e.g. corrosion and/or scour) in the test specimens.

The ultimate goal is to reduce the life-cycle costs of OWTs by better assessing their performance based on sensor data.

Project organization and time plan

The industrial PhD project is a collaboration between DTU Civil Engineering department and COWI A/S. The PhD candidate is Mads Greve Pedersen. The main supervisors for the project are Rune Brincker (DTU) and Isaac Farreras Alcover (COWI A/S). The project is expected to take place in the period from September 2021 to September 2024.