Keywords: Offshore Wind Turbine, value of information, Structural health monitoring.

On the value of SHM information for offshore wind turbines

Lijia Long[a,b], MAI Anh Quang [c],John Dalsgaard Sørensen [b] and Sebastian Thöns [a,d]

Applications of Structural Health Monitoring (SHM) for the design and analysis of Offshore Wind Turbine (OWT) structures has gained much attention within the past few years. Being exposed to repeated cyclic wind and wave loads, OWTs are dynamically sensitive structures and can benefit from monitoring systems to predict time-dependent deterioration. This study focuses on the quantification of the value of SHM information on the maintenance of OWT structures, with emphasis on fatigue of welded joint. By utilizing the decision tree, structural reliability, SHM data, as well as the cost-benefit assessments, a value of information (VoI) analysis can be done to model the fundamental decision of whether the service life of an OWT foundation can be extended beyond the initial design life.

The application is demonstrated on a butt weld of a monopile support structure of a 3 MW offshore wind turbine with a hub height of approximately 71m where the prior probability analysis is modelled as a probabilistic fatigue damage model based on S-N approach and designed wind data. The posterior probability of failure of welded joints is updated using the three-year measured oceanographic and one-year strain data.

The expected value of SHM information can be found as the difference between the maximum utility obtained in posterior analysis with SHM information and the maximum utility obtained using only prior information. This work can provide insights on how much benefits can be achieved through SHM information, with practical relevance on reliability-based design optimization and fatigue life extension of OWT structures.

---

[a] Department 7: Safety of structures, BAM Federal Institute for Materials Research and Testing, Berlin, Germany
[b] Department of Civil Engineering, Aalborg University, 9100 Aalborg, Denmark
[c] Faculty of Applied Sciences, University of Liege, Liege, Belgium
[d] Dept. of Civil Engineering, Technical University of Denmark, Lyngby, Denmark