BUILT TO LAST

POWER-US
PARTNERSHIP FOR OFFSHORE WIND ENERGY RESEARCH

Optimal sensor placement for physics-based digital twins

6 MW Block Island Turbines
Rhode Island State Waters

7 MW Levenmouth Turbine
ORE Catapult, UK

US-UK Bilateral Project Update: Optimal Sensor Placement

Tufts and the University of Rhode Island have assembled an international team of researchers to advance the state of the art in structural health monitoring and digital twin technology. Results from this work will lead to improved commercial-scale structural health monitoring systems for offshore wind turbines, helping to reduce operations and maintenance costs, increase the safety of the offshore wind industry, and extend the lifespan of offshore wind turbines.

The $2.5+ M project began in 2019 with plans for instrumentation of the 6 MW Block Island wind turbines, and was extended in December 2020 to include the 7 MW Levenmouth Turbine managed by the UK Offshore Renewable Energy Catapult (OREC). This Innovate UK funded element of the project is led by Transmission Dynamics, who deliver world leading Internet of Things based Smart Sensor Networks and specialize in remote wind turbine condition monitoring solutions. They are partnered with Unasys Ltd who specialize in interactive 3D asset representation and who will develop the physics-based digital twin of the Levenmouth Turbine.

Digital Twinning Technology for Predictive Capacity ⇄ **Advanced Design of Safer Systems**

UK Offshore Wind Industry ⇄ **US Offshore Wind Industry**

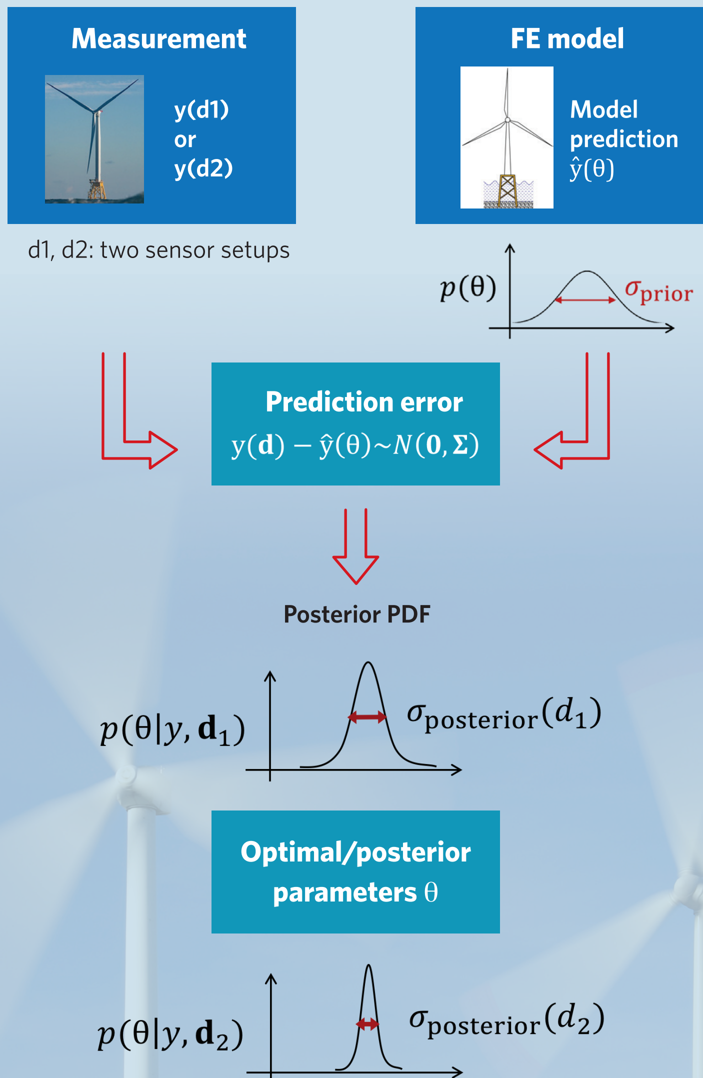
Reduced Operations and Maintenance Costs, Increased Safety and Longer Design Life

THE UNIVERSITY OF RHODE ISLAND

Tufts UNIVERSITY

Methodology

Advanced Bayesian algorithms enable the selection of optimal sensor placement scenarios through physics-based models, iterative analysis, and rigorous uncertainty quantification. The resulting digital twins are smart, adaptable, and capable of remote damage detection.



Sensor setup d_2 gives smaller posterior uncertainty → better

Information Entropy:

$$H(\mathbf{L}|\boldsymbol{\Sigma}, D) = E_{\theta}[-\ln p\,(\theta|\boldsymbol{\Sigma}, D)]$$

This US-UK bilateral project will provide the basis for powerful collaboration, intelligence sharing, combined expertise, and resouces to drive reductions in the levelised cost of energy (LCoE) of US and UK offshore wind farms.