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Machine learning concepts for effective maintenance of next generation offshore wind turbines

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Introduction

Offshore wind is suggested to reach a capacity of 800 GW by 2021 according to the World Wind Energy Association (WWEA). Indicating a global increase in the manufacturing, maintenance, and operations of wind turbines. Global Wind Energy Council (GWEC) predicts an increase in efficiency contributing significantly to the expansion. The application of new technologies will reduce the Cost of Energy (COE). The United Kingdom industry report states that operations and maintenance (O&M) contributes to 20-25% of the lifetime cost of an offshore wind farm, unexpected failures can increase this cost. O&M costs are expected to reach $20.6 billion in 2023 by National Renewable Energy Laboratory (NREL). Reducing the O&M costs is directly related to achieving the targets set above and adhering global and national carbon footprint reduction agreements.
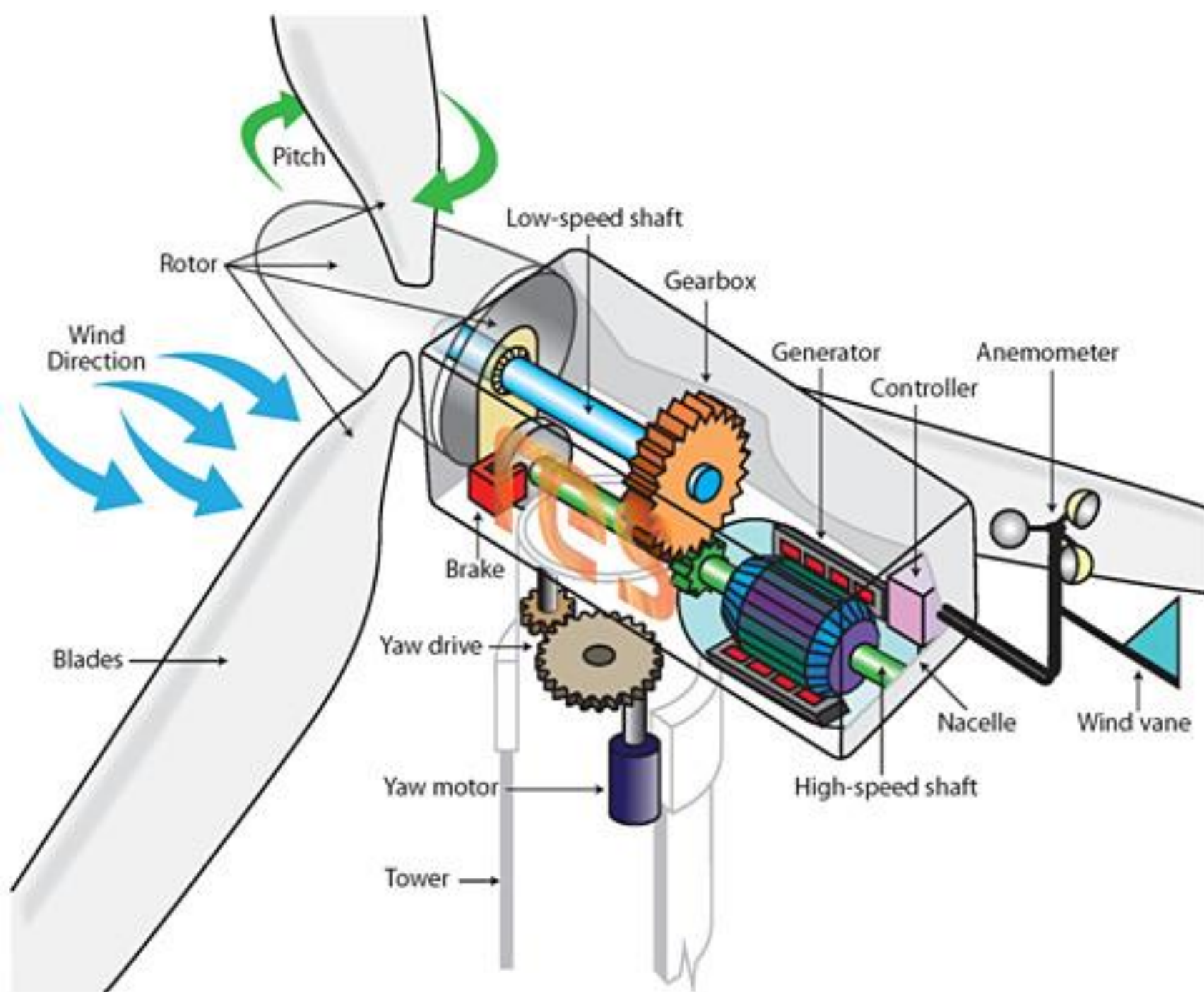

Conditional monitoring (CM) techniques are used to detect the performance of wind turbines determining abnormal behavior indicative of faults, in the case above, that would be any of the components. Utilising CM with effective approaches will determine failures earlier and catastrophic loss can be avoided.

Aims and Objectives

Wind farms equipped with SCATA system record valuable information on turbine operations with minimal extra cost. Interpreting this information is main aim of this project, specifically:

- Understanding current machine learning techniques applied to failure detection.
- Apply machine learning techniques to determine failure modes.
- Critically analyse what are the most effective method suited to specific failure modes.

Methodology
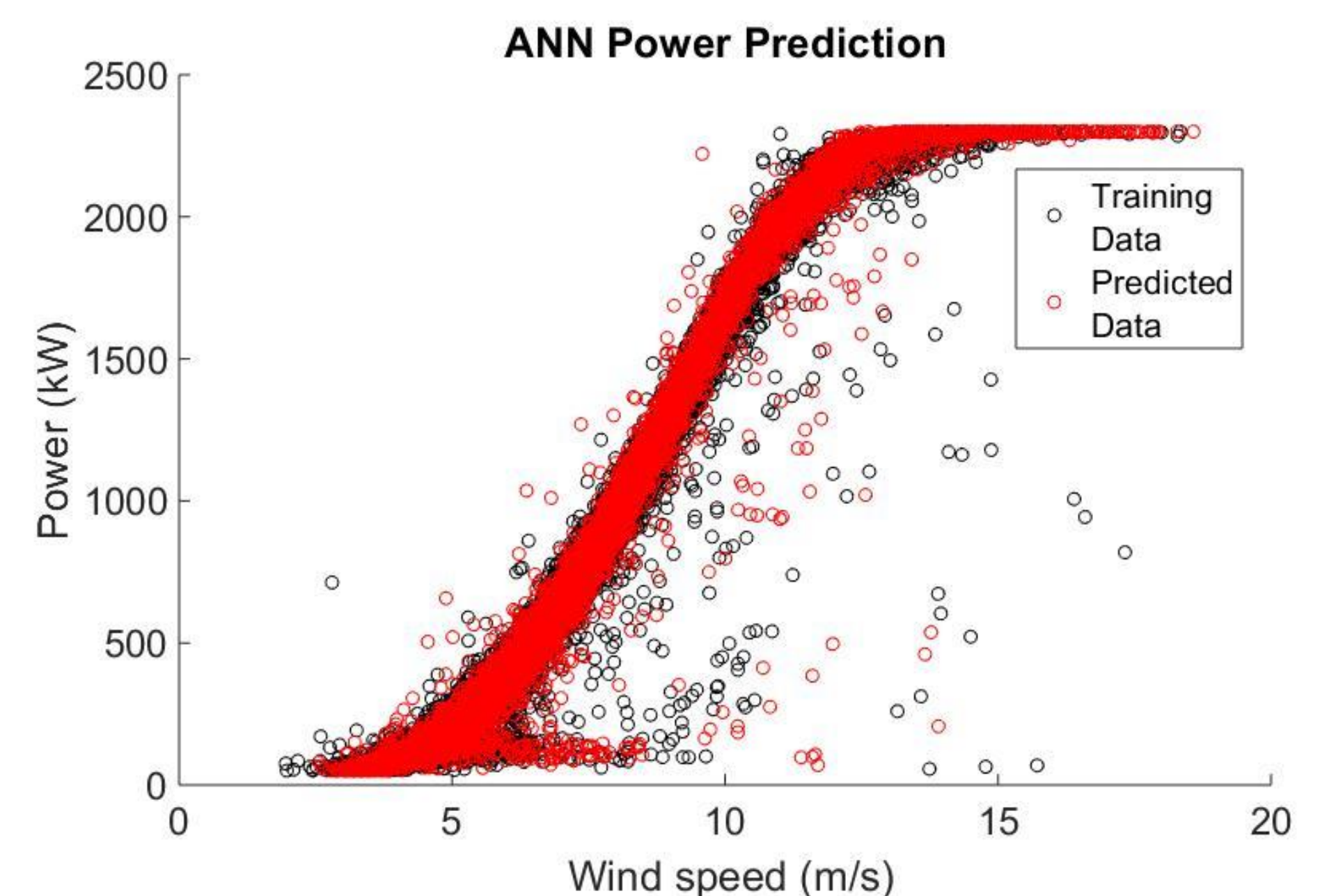
There are many machine learning techniques. Above, I have explored an Artificial Neural Network's (ANN) ability to predict the power using wind speed for a horizontal axis wind turbine. This information can be used in tandem with; pitch angle, blade rotational speed, temperature, etc. to determine operational faults and apply the correct mitigation strategy to increase the life cycle of the asset or power.

Reference

Figure - www.beaufortcourt.com/energy-generation/windenergy,