VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Faras Jamil**

The public defense will take place on **Thursday 3rd December 2026 at 3pm** in room **D.2.01** (Building D, VUB Main Campus)

To join the digital defense, please click here

ADVANCED MACHINE LEARNING FOR AUTOMATED, EXPLAINABLE, AND SCALABLE CONDITION MONITORING

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Abstract of the PhD research

Offshore wind turbines operate in harsh and constantly changing environments. When critical drivetrain components, such as bearings or gears, begin to degrade, unexpected failures can cause costly repairs and lost energy production. Early detection of potential failures is therefore essential to ensure reliable, affordable renewable energy generation.

This thesis investigates how machine learning can automate condition monitoring by analysing wind turbine vibration signatures. The developed methods continuously monitor turbine behaviour, detect early signs of degradation, and highlight patterns associated with emerging faults. The proposed approaches automate the time-consuming task of routine machine health monitoring and provide experts with actionable insights when attention is required, allowing them to focus on fault investigation and maintenance planning.

The research is validated using real operational data from the Belgian offshore wind fleet. By automatically identifying abnormal behaviour and supporting fault investigation, the proposed frameworks help experts make faster and better-informed maintenance decisions, contributing to safer, more reliable, and more cost-effective offshore wind energy.