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AI for wind turbine predictive maintenance

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Abstract:

To ensure competitiveness, wind turbines (WTs) need to harness the power of artificial intelligence (AI) and data analytics to operate reliably with maintenance strategies that are both efficient and effective. It's crucial for the wind power sector to embrace a transition from traditional corrective and preventive maintenance towards a more sophisticated, predictive maintenance model. This model uses the vast amount of data collected from the WTs and employs AI to implement maintenance precisely when needed. This presentation focuses on two primary aspects of this transition.

First, we examine the methodologies for condition monitoring of WTs through the analysis of SCADA data. Wind turbines generate a significant volume of SCADA data from numerous sensors, which, when combined with AI, can be effectively utilized for early predicting potential faults. Techniques driven by data are particularly promising in this area as they are highly cost-effective.

Second, the discussion turns to the structural health monitoring (SHM) of WTs. The objective here is to identify, locate, and assess structural damage, thus enabling timely maintenance interventions. The conventional SHM strategy, which relies on guided waves and presupposes known input excitations for measuring the resultant vibrations, is not directly applicable due to the unpredictable nature of wind, waves, and currents as sources of excitation. Consequently, a novel approach is introduced: a methodology that only relies on vibration responses.

In essence, this keynote underscores the imperative shift towards predictive maintenance, underpinned by the innovative use of AI and data analytics.

Short biography of Prof. Dr. Yolanda Vidal Seguí



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Yolanda Vidal holds a degree in Mathematics (1999) and a PhD in Applied Mathematics (2005) from the Universitat Politècnica de Catalunya (UPC), Barcelona, Spain. As an Associate Professor at UPC and an IEEE Senior Member, she actively engages in multidisciplinary research. Her areas of expertise include condition monitoring, structural health monitoring, fault diagnosis and prognosis, predictive maintenance, machine/deep learning, mathematical modeling, and the application of these disciplines in wind turbine technologies. She serves on the Editorial Board of several international journals, including Engineering Applications of AI (Elsevier), Wind Energy (Wiley), Wind Energy Science (Copernicus), Mathematics, Sensors, Energies, Frontiers in Built Environment, and Frontiers in Energy Research. Her prolific contributions are evidenced by more than 60 high-impact journal articles, 20 competitive R+D+I projects, 17 book chapters, 10 books, 3 supervised PhD theses, 1 invention patent, a collaboration contract with an industry partner, and over 110 conference papers.