Dear Referee #2,
First and foremost, thank you for reviewing our paper *"Uniform Blade Pitch Misalignment in Wind Turbines: a learning-based detection and classification approach" (Preprint wes-2025-153).* We are glad that your feedback was positive.
We have carefully revised the original manuscript to accommodate all your suggestions, taking this opportunity to make minor improvements to the text. In the amended version of the paper, the changes marked in orange refer to your comments. The point-by-point reply to your comments is reported here below.

General comments

I think a more detailed review of the literature, further consideration of the physics (i.e. to help describe what the ML algorithm is likely identifying), and consideration of how this might be applied in reality and the potential limitations in doing so would be beneficial. The paper is otherwise well written. Thanks

[Reviewer] Line 117 do not in italics. Line 122, worthwhile instead of worthless.

[Answer]
We thank the Reviewer for the suggestion. We agree that the term should not be entirely in italics. However, worthless was intentionally used to stress that, in this specific case, the power curves do not convey meaningful information.

[Action] We changed the text accordingly.

[Reviewer] Figure 2. What's the sampling rate?

[Answer] The sampling rate used to generate Figure 2 is 5 Hz.

[Action] We have now clarified this point in the text of the manuscript.

[Reviewer] Figure3. Can you show the pitch curve too? i.e. pitch vs wind speed? This should highlight the physics of the pitch offset above rated. Can you also state what the anomaly shown is, e.g. 2 degree positive offset?

[Answer]
We thank the reviewer for the suggestion. We agree that showing a pitch–wind speed characteristic helps to better highlight the physical effect of a uniform pitch offset in Region III (above rated), where power regulation is achieved through collective pitch control. In the revised manuscript, we added an additional plot reporting the mean collective demanded pitch versus wind speed for healthy and uniformly misaligned cases. We clarify that the pitch signal shown corresponds to the controller collective pitch demand (used by the turbine to compensate the altered aerodynamics), since the direct "faulty pitch" is not an independent measured signal in the considered setup. We also explicitly state in the figure caption and text the magnitude of the considered anomaly (e.g., a uniform -1.5deg pitch offset applied to all blades).

[Action] Figure 3 has been modified accordingly.

[Reviewer] Above rated, for the non-turbulent case, I would expect it to be trivial to compare the set point of the pitch misalignment between healthy and anomalous cases, and so determine the offset, since the controller will adapt to the offset accordingly and will simply shift the curve up/down by the offset.
The issue with a real turbine is that you do not know what the healthy state is, and even if different offsets are applied, it wouldn't be clear which one is "best" above rated power, because the power output will be the same.
Below rated, then we'd look for the offset that maximises generation. My concern would be that in reality noise would mask small changes in toque/power output, so might be difficult to detect.
In addition, I don't see the advantage of looking at bending moments over just using power directly. Bending moments are likely to have much higher uncertainty in the real world than the power measurements.
Have you also considered looking at using SCADA data, which is typically stored at 10-min resolution?
Would you be able to offer some commentary on these points?

[Answer]
We agree that, in an ideal non-turbulent scenario with direct access to pitch measurements and a known healthy reference, the pitch offset above rated wind speed could be trivially identified, as the controller would adapt by shifting the pitch curve accordingly. In this case, the offset could indeed be estimated by comparing the set-points between healthy and anomalous conditions. However, this situation does not reflect realistic operating conditions, where neither the healthy reference nor the absolute pitch offset is known a priori. Moreover, as correctly stated by the Reviewer, above rated wind speed the controller enforces power regulation, so different pitch offsets may lead to indistinguishable power outputs. This intrinsic ambiguity above rated power is precisely one of the motivations of this work. As discussed in the manuscript, uniform pitch misalignment has a symmetric effect and may not manifest through power deviations, even in the presence of a fault. For this reason, power alone cannot be used to identify which offset is "best" or even to detect the anomaly. Below rated wind speed, an optimal pitch offset could in principle be inferred by maximizing power production. However, as the Reviewer correctly points out, in real turbines small changes in torque or power may be masked by measurement noise and environmental variability. This limitation is explicitly acknowledged in the paper and motivates the use of longer time windows and complementary indicators, as shown in the NTM analysis. While power measurements are typically more accurate than load measurements in operational turbines, power is strongly regulated above rated wind speed and therefore becomes weakly informative for uniform pitch misalignment. In contrast, bending moments are directly linked to aerodynamic loading and reflect the redistribution of forces induced by pitch offsets, even when power remains unchanged. We acknowledge that bending moments may be affected by higher uncertainty in real-world measurements; however, they provide sensitivity to fault signatures that are fundamentally invisible in power signals. This trade-off is now more clearly discussed in the manuscript. Regarding the use of SCADA data, we agree that SCADA measurements at 10-minute resolution are highly relevant for practical deployment. However, experimental SCADA data are not available in the context of this study. The results presented in the manuscript are based on simulation data, including aggregated time windows of up to 10 minutes, which are intended to resemble the temporal resolution typically associated with

SCADA systems. The purpose of this analysis is to assess the robustness and detectability of uniform pitch misalignment under realistic temporal aggregation, rather than to provide a full experimental validation. The application and validation of the proposed approach using real SCADA data is therefore considered a natural and important direction for future work.

[Action] -

[Reviewer] Check colors in the figures

[Answer]
We have revised all the figures in the manuscript.

[Action]
We have revised all the figures in the manuscript.

[Reviewer] Figure 8. A real turbine will be operating day-in day-out, so having a longer time window is not a limitation, especially for something like pitch misalignments, that are generally static (i.e. don't vary with time).

[Answer]
We thank the Reviewer for the comment and we agree with this observation. Indeed, for real turbines operating continuously, the use of longer time windows is not a practical limitation. On the contrary, for quasi-static faults such as uniform pitch misalignment, longer observation windows are naturally available and beneficial.
As shown in Figure 8, increasing the time window improves the robustness and accuracy of the detection and severity assessment, particularly under turbulent conditions. This result therefore supports the practical applicability of the proposed approach rather than representing a limitation. We have clarified this point in the manuscript to avoid ambiguity.

[Action] -

[Reviewer] I think potentially you need to do a search of wind turbine control literature. Perhaps searching for Cp-lamda or performance coefficient optimisation. I think this has been historically approached as a control optimisation problem (i.e. what is the best fine pitch angle to maximise production), rather than offset/error identification problem.
Extremum Seeking Control (ESC) seems to come up a few times for this: e.g. "Maximizing Wind Turbine Energy Capture using Multivariable Extremum Seeking Control."
There's also an example of doing this in reality, which is pretty cool: "Experimental Evaluation of Extremum Seeking Based Region-2 Controller for CART3 Wind Turbine."

[Answer] We thank the reviewer for pointing out the connection with the wind turbine control and C_p–λ optimisation literature. We agree that performance coefficient optimisation and fine pitch tuning have been historically addressed as control optimisation problems, rather than as offset or fault identification tasks. Extremum Seeking Control and related approaches have indeed been proposed to maximise energy capture by continuously adapting the pitch angle, and have shown promising results both in simulation and experimental studies. The manuscript has

been revised to acknowledge this body of work and clarify the distinction with respect to the proposed approach.
While control-based optimisation methods aim at continuously adjusting the pitch to maximise aerodynamic efficiency, the objective of this work is to detect and identify collective pitch offsets as abnormal conditions within a proactive monitoring framework. In this sense, the proposed method is complementary to control optimisation strategies, as it focuses on fault awareness and diagnosis rather than on online control adaptation.

[Action] The related works section has been modified accordingly.

We look forward to your kind reply, and in the meanwhile, we send our warmest regards.

Sincerely yours,

Sabrina Milani, on behalf of all Authors.