

Dear Reviewers,

We would like to sincerely thank the reviewers for their time and the constructive feedback provided on our manuscript. We appreciate the positive reception of our work and the insightful suggestions, which have significantly helped us improve the clarity and depth of the paper.

Below, we have provided detailed responses to each of the points raised. We have addressed the reviewers' comments by revising specific sections, adding new subsections where requested, and refining the text to maintain a balance between comprehensiveness and readability. All changes made in the manuscript are highlighted in the revised version.

Comments from Reviewer 1 and responses:

General Comment from the Reviewer:

This is a very good, wide-ranging position paper on the subject. The group of distinguished authors have done an excellent job of coordinating such an informative work. It will be of interest to readers of the journal and should be published. Because it is so broad in scope, it is rather long. However, it is hard to see how any individual sections could be reduced. It might perhaps have been better published as a book, but if the journal board is happy with this format, so am I. It can be published as it is. I have suggested some minor points that may be of help to the authors.

- **Response:** We sincerely thank the reviewer for their highly encouraging words and for taking the time to review our manuscript. We are glad that the comprehensive nature of this position paper was well-received. We have carefully addressed all of your minor points and suggestions, which have helped us polish the final text. Furthermore, we agree with your observation regarding the length of the manuscript. In response, we have condensed several sections throughout the paper, including implementing your specific suggestion to restructure Section 5.2.2.

Comment: Section 1.1, p.2 – Consider starting with the formal definition of a drivetrain (it does appear later, so this is a minor point).

- **Response:** As the reviewer correctly noted, a formal definition and detailed explanation of the drivetrain are provided in the subsequent chapter. To avoid redundancy, we decided not to add this information to Section 1.1.

Comment: Section 1.2.2 – A few references here would be useful.

- **Response:** We agree that this section was lacking adequate literature support. We have now incorporated relevant references throughout this section.

Comment: Section 1.2.2 – It would make sense to list these either in order of importance or in the order they appear in the drive train.

- **Response:** We have rewritten this section to present the information in order of importance, as suggested. We decided to use standard paragraphs rather than a bulleted list. However, we improved the order of the main failure modes and components here, and we discuss them in full detail in Section 2.

Comment: Section 1.3.1 – How about presenting these levels as bullet points for quicker reading?

- **Response:** Thank you for this suggestion. We agree that using bullet points makes these levels much easier to read. We have updated this section and used the same bulleted format in other similar parts of the paper.

Comment: L216–219 – It would be helpful to include a sentence giving examples of what these risks might be.

- **Response:** We have added an additional sentence to explicitly provide examples of what these risks entail.

Comment: L225 – Remove “etc.”

- **Response:** The word "etc." has been removed.

Comment: L250–260 – This paragraph feels somewhat out of step with the paper. It is not clear what “Task 43” (and the later “second phase”) refers to, or what the organisational body is. This paragraph reads more as a description of task objectives and does not fit the overall narrative of the paper, which is about status.

- **Response:** We agree with the your assessment that this paragraph felt somewhat out of scope and focused too heavily on project objectives. We have rewritten this text in a more generalized manner, maintaining the overall narrative on the status of the field and citing "Task 43" simply as an example of a project that addresses these data challenges.

Comment: Section 3.1.1 – This is a comprehensive list of ML methodologies, but it lacks a clear takeaway message — e.g., which tools are best or most appropriate, or some guidelines for the operator. Table 1 is good and visual; could some of the extensive text in Sections 3.1.2 and 3.1.3 be replaced with a similarly well-crafted table?

- **Response:** We appreciate the reviewer's insight. To provide a clearer takeaway, we have refined the conclusion of this section to better guide the reader. Regarding the use of a table for Sections 3.1.2 and 3.1.3, we felt that the nuances of these methodologies required narrative explanation. To keep the paper's length under control, we chose not to add a table. We believe the current text explains the methods more accurately than a simplified table could.

Comment: L727 – “This section has summarised...” use past tense

- **Response:** The phrasing has been corrected to the past tense as suggested.

Comment: L731 – The phrase “according to the failure mode” — is it clear in the preceding section which steps are required for which expected failure mode?

- **Response:** Expanding on exactly which preprocessing techniques are needed for specific failure modes would require an entirely new section. Given the current length of the manuscript, we are more inclined to remove text than to add to it. Therefore, we have simply removed the phrase "according to the failure mode" from the sentence to avoid confusion.

Comment: L1076, L1133 – Use the SCADA acronym, as it is now well established in the paper.

- **Response:** We have updated these instances to use the established SCADA acronym.

Comment: L1425 – Autarkic is an uncommon word; I had to look it up. According to Wikipedia, autarky means self-sufficiency, usually applied to societies, communities, states, or economies. Is this the correct word in this context?

- **Response:** We agree that "autarkic" is an uncommon term and was redundant in this context. It has been removed.

Comment: L1462–1466 – The paper should report only work or concepts that have already been achieved, not future plans.

- **Response:** This section has been removed so that the text exclusively reports on achieved work and concepts.

Comment: Section 5.2.2 – CMS Signal Processing – The unnumbered sections on SAW and TFM do not fit well under this title (they are also not unique to gearboxes, which is the focus of Section 5.2). A lot of space is dedicated to SAW and TFM, which are two new sensor concepts, but very little is given to oil debris monitoring, which is well established. This feels out of balance.

- **Response:** The reviewer makes a very valid point. The sections on SAW and TFM were too detailed compared to other methods and made the chapter feel unbalanced. To fix this, we shortened those discussions into two small paragraphs and moved them to the 'Plain Bearing' section.

Comment: L1648 two periods ..

- **Response:** The typo has been corrected.

Comments from Reviewer 2 and responses:

Comment: Several important statements would benefit from stronger and more specific literature support. For example, the sentence “The emergence of floating offshore wind turbines (FOWTs) further introduces platform-induced motions and additional dynamic loads, amplifying the operational stresses on critical components” should be supported by relevant and up-to-date references that explicitly quantify or demonstrate these effects.

- **Response:** We have made the suggested change. The indicated sentence has been updated with relevant and up-to-date references that support these effects. Further details on the restructuring and referencing of this section are provided in our response to the next comment.

Comment: In Section 1.2.2, I recommend restructuring the discussion. It would be clearer to first summarize the main failing components and dominant failure mechanisms that are common across wind turbines in general, and then explicitly highlight the additional or emerging challenges specific to offshore and floating offshore wind turbines (e.g., harsher environments, coupled dynamics, accessibility constraints)

- **Response:** Thank you for the suggestion. We have entirely rewritten Section 1.2.2. Addressing both this comment and Comment 1, we have added relevant citations to the indicated sentences, as well as to other statements that previously lacked clear references. Regarding the structure, we now clarify the general failure mechanisms first. However, we did not draw a strict distinction between fixed offshore and floating offshore wind turbines. This paper primarily focuses on onshore and fixed-bottom offshore systems. While the discussed challenges and condition monitoring techniques may apply to floating systems, a detailed analysis of floating wind turbines falls outside the intended scope of this review.

Comment: While the manuscript provides a comprehensive overview of existing condition monitoring (CM) techniques, the discussion remains largely descriptive. The authors are encouraged to more clearly articulate the methodological novelty of this review and to emphasize recent or emerging CM paradigms rather than primarily consolidating established approaches.

- **Response:** We thank the reviewer for this feedback. We agree that it is important to clearly state the novelty of our review and highlight newer technologies. To address this, we have added a new subsection at the end of the Introduction (Section 1.5: Contributions and novel perspectives of this review). This section outlines our focus on recent developments, such as digital twins, deep learning, and video-based analysis, and emphasizes how we connect raw data acquisition directly to practical O&M decision-making, rather than just summarizing established methods.

Comment: The current structure follows a technology- and method-centric organization, which makes it difficult to identify the underlying review logic. Reorganizing the manuscript around key CM problems (e.g., fault detection, diagnosis, prognosis, and decision-making) or fundamental challenges (e.g., data scarcity, generalization, interpretability) could significantly improve clarity.

- **Response:** We appreciate the reviewer's comment regarding the structure of the manuscript. While the subsections focus on specific technologies, the overall paper is actually organized around the key CM problems you suggested: fault detection and diagnosis (Section 3), prognosis

and RUL (Section 4), and decision-making (Section 6). To make this structure more obvious to the reader from the start, we have added a new subsection to the Introduction (Section 1.6: Organization of the manuscript) that clearly explains how the paper is laid out according to these core CM challenges.

Comment: Section 1.3 provides a solid conceptual overview of digital twins; however, it remains largely at the framework and terminology level. A more critical discussion comparing how different modelling strategies (data-driven, physics-based, and hybrid) actually improve CM performance would strengthen this section.

- **Response:** We appreciate this feedback. We have revised Section 1.3 and its subsections to include a more critical discussion. The updated text now explicitly compares data-driven, physics-based, and hybrid modeling strategies, detailing how each approach practically improves condition monitoring performance.

Comment: The SCADA-based CM section is extensive, but it does not sufficiently discuss fundamental limitations such as limited observability of early-stage mechanical faults, temporal resolution constraints, and confounding environmental effects. Explicitly addressing what SCADA-based methods cannot reliably detect would add critical depth.

- **Response:** We agree that this was a missing element in the original manuscript. To address this, we have added a new subsection (Section 3.1.4: Limitations and drawbacks of SCADA data for condition monitoring of wind turbines), which explicitly discusses temporal resolution constraints, environmental effects, and the limitations in observing early-stage mechanical faults.

Comment: While prognostics and remaining useful life (RUL) estimation are mentioned, the manuscript does not adequately analyze why these methods are still rarely adopted in industry. A discussion of challenges such as uncertainty quantification, validation difficulty, and integration with maintenance decision-making is recommended.

- **Response:** We agree that addressing the gap between academic RUL research and industrial application improves the quality of the review. We have added a new subsection (Section 4.4: Challenges in the industrial adoption of RUL estimation) that provides a focused discussion on uncertainty quantification, validation difficulties, and the integration of RUL estimates with actual maintenance decision-making, while keeping the overall length of the paper within reasonable limits.

Comment: Although offshore and floating turbines are referenced throughout the manuscript, their CM challenges are not systematically contrasted with onshore turbines. A clearer and more explicit comparison would help readers understand what genuinely changes for CM when moving from onshore to offshore and floating systems.

- **Response:** Thank you for this constructive feedback. While an explicit, systematic comparison of onshore, fixed offshore, and floating drivetrains would certainly broaden the scope of the paper, we decided against adding it to maintain conciseness. Our goal is to provide a comprehensive positioning paper on drivetrain condition monitoring generally, without expanding the

manuscript to a book-length comparison of specific operating environments. We hope the reviewer understands this editorial choice.