

Rebuttal

We would like to extend our gratitude to the reviewers for their thorough evaluation of our manuscript and for providing insightful feedback. Your constructive comments and suggestions have been invaluable in guiding the revisions and improving the quality of our work. We have carefully considered each point raised and have made the necessary revisions to address the concerns. Below, we provide a detailed response to the reviewers' comments.

Reviewer #1

No comments were provided by reviewer #1

Reviewer #2

1. Minor comments with respect to grammar issues of the paper:

1) In the paragraph below line 35, two 'the' were used in "...however, there remain research questions on the sources and the magnitude of the the virtual measurements' uncertainty."

2) In e.q. (22), one parentheses is in the wrong place, please check.

3) In the sentence above line 320, it says "Based on these results it a measurement resolution of at least 1 Hz is recommended for load and fatigue damage monitoring in wind turbine drivetrains", here the 'it' shall be removed? please check.

4) In line 456, Tab. 4 is not given in the paper, which shall be Tab.3? Please check and update.

The grammar mistakes have been corrected.

2. In line 196, it says "...Nonetheless, the full wind spectrum is covered.". How to understand this? A brief explanation shall be given here for a better understanding.

The amount of data for each wind speed bin is sufficient to characterize the dynamic behaviour in the full range of operational conditions, which allows the comparison with simulated data from the numerical case studies.

3. For dynamic analysis, how to determine the damping values is usually a challenging task. For the numerical simulations performed in the paper (global analysis and local drive train analysis), what kind of damping models were applied? and what are the damping values commonly used? It is recommended to include more detailed information about the estimation of damping in the paper.

A description of the damping models was added to Sec. 2.4. The full-order models comprise a large number of components with different damping models. Bearing and gears are typically modelled as spring-damper connections with stiffness proportional damping of about 1% and 0.1%, respectively. Flexible bodies such as the main shaft are modelled as condensed FE models, which are derived from FE models by modal reduction techniques. Here, modal damping of 2% is considered. The reduced-order model considers only one torsional damping constant, as described in Sec. 2.5. To allow the comparison of ROM and FOM, the equivalent torsional damping constant of the FOMs is adopted from Wang et al. (2020) and Nejad et al. (2016) and verified with decay tests. This value is considered the ground truth and compared with the damping parameter estimates obtained by system identification methods.