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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Fatigue lifetime calculation of wind turbine blade bearings considering blade-dependent load distribution" *by* Oliver Menck et al.

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The authors have developed a well-written and useful paper comparing 3 different methods for the calculation of the fatigue life of wind turbine blade pitch bearings. One general comment I have is that there is no discussion of the failure modes typically seen in this application; that is, do these bearings fail by subsurface fatigue? Are there any data sources or examples that might show this? If not, then this reviewer suggests that this be discussed in the Introduction. Additional specific comments on the paper are provided below.

The Abstract and Sections 2.6.2 and 2.6.3 could be written more clearly with respect to

the fact that some of the methods appear to have been modified from those originally published for application to the double-row, 4-point contact ball bearings used in large, modern wind turbines. Here, by "modified", I refer primarily to the calculation of a dynamic equivalent load specific to this application. In particular for ISO 16281 in section 2.6.3, it is not clear at what point the methodology departs from the standard itself – is it equation (7) or not? The Conclusions are better written in this respect.

In the Introduction, the sentence "IPC turns blades individually in order to reduce asymmetrical rotor loads which contribute significantly to fatigue loading" would be clearer if the components or systems of interest were listed. The blades, the blade bearings, the gearbox bearings?

In Section 2.3, Figure 1 is not particularly useful as shown. If it is available, a solid body model with a cutaway view showing the components of interest would be better.

In Section 2.5, the sentence "The axial force Fz has a barely noticeable effect on the load distribution as the resulting axial forces from the tilting moment tend to be much higher" could be written more clearly. I believe the intent is "The axial force Fz does not have an appreciable effect on the load distribution within the bearing as the internal axial reaction forces resulting from the tilting moment tend to be much higher". Additionally, the sentence "Radial forces Fx and Fy result from the usage of a lever arm measuring 40m during all simulations" is not clear.

The first sentence in Section 2.6 should be "All the standards and guidelines mentioned in Sect. 1 calculate rolling contact fatigue lifetime as". Also, in equation (2), the parameter fcm is not defined and should be. I believe the phrase ". . .the figure is generally provided by the bearing manufacturer" is intended to mean ". . .the load rating is generally provided by the bearing manufacturer". The final sentence, I believe, should read "Three different calculation methods for determining the dynamic equivalent load will be presented in the following sections,. . ."

Section 3.1.1 has typos where "spare" caps should be "spar" caps. Is the statement

"...equivalent loads of variant NREL 2 are less than those of ISO 16281 in 99.9% of cases" correct? Isn't it vice versa? That is, isn't NREL 2 just slightly higher than ISO 16281? Finally for section 3.1.1, do the authors have any comment on the relatively low number of operating hours or cycles for any of the methods? What does this say about the state-of-the-art relative to pitch bearing design and existing failure rates as seen in the field? This is mentioned in the Conclusions, but the Results section would benefit from lengthier description here.

In casually glancing at the Acknowledgements, reference is made to the project "HAPT – Highly Accelerated Pitch Bearing Tests". Are there any testing results from the project that might inform or be used to validate the simulations presented in this paper? Maybe that is contained in the existing References. If so, this could be highlighted more.

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