Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2019-84-AC1, 2020

WESD

Interactive comment

Interactive comment on "A novel rotor blade fatigue test setup with elliptical biaxial resonant excitation" *by* David Melcher et al.

David Melcher et al.

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Received and published: 13 March 2020

Referee comment:
I think this is a very interesting piece of work - I tried something similar to this during my PhD, but using much less robust methods. I found that the masses which were required seemed very high to me at the time, but I didn't appreciate that there are methods of applying these virtual masses which do not require them to be at the same height as the blade. This test method has the advantage over the test optimisation method being pursued by ourselves and others (in which the frequencies do not need to coincide) that much less information sharing needs to take place between test house and customer, but perhaps at the expense of a more challenging test set-up process.

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Author response:
Thank you for the appreciative comments.

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Referee comment:
I think it is very important that you validated your results with a nonlinear time-stepping simulation as the nonlinearities could lead to significant angular changes of the push rods.

Author response:
A nonlinear time-stepping simulation has been performed as mentioned on page 7 line 9-11 and page 10 line 3-5. The angular changes of the pushrods occurred, but did not significantly change the results compared to the harmonic simulation. The angular changes also depend significantly on the length of the pushrods. The longer the pushrods, the smaller the angular changes. At outboard positions with high deflections the pushrods would need to be unreasonably long to prevent high angular changes. Hence, at the most outboard positions no load elements requiring pushrods were allowed in the test desing.

Corresponding change #1:
Page 7 line 9: A transient simulation of the test, **considering nonlinear damping and nonlinear geometric effects, such as angular changes of load introduction elements**, requires about 100 times more processing time. A comparison of transient and harmonic simulations yielded less than 3% difference in loading amplitudes within the area of interest. **Hence, the harmonic results are sufficiently precise. Nevertheless, the final test setup needs to be checked by a transient simulation.**

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Referee comment:
For the iteration to obtain the aerodynamic loads, I have considered a different way of

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doing this which may be of interest: 1 - Scale the mode shape so that the test loads match the target loads in a least squared sense 2 - Calculate energy dissipated during cycle by aerodynamic and structural damping (using a damping matrix generated by Rayleigh method) 3 - Use the actuator displacement to calculate the actuator force by equating the energy in (integral of actuator force x distance over cycle) to the energy out (air resistance and structural damping)

Author response:
Interesting method, but as I understand this only helps to predict the required actuator force. The effect of aerodynamic damping on the load distribution cannot be predicted, which was the goal in the present work.

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Referee comment:
If it is possible, it would be very interesting to know a rough size range for the blade (I appreciate you can't share the exact length as this can identify the blade) as this would help contextualize the magnitude of the loads and masses required.

Author response:
The Blade length is above 60m.

Corresponding change #2:
Page 7 line 9: In this work, a modern industrial rotor blade **of more than 60m in length** is used to demonstrate the developed method.

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Referee comment:
Overall, congratulations on a great piece of work!

Author response:
Thank you for your helpful comments!

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