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Interactive comment on "Establishing a robust testing approach for displacement measurement on a rotating horizontal axis wind turbine" *by* Nadia Najafi and Allan Vesth

Anonymous Referee #3

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General Comments

This work aims at developing a new 3D photogrammetric calibration technique which can be used for infield vibration tests on utility-scale horizontal axis wind turbines. For this purpose some dynamic experiments and measurements are conducted on a small scale wind turbine model in the lab.

Regarding the content, the methods described in the article can be very useful for the lab tests but unfortunately they are not applicable to the infield tests efficiently as claimed. Therefore, the paper needs significant major revisions in order to show that the proposed system can also be used in the field. Below you can see my recommen-

dations

1- The term photometry is mis-used in the text. I think this word should be corrected as photogrammetry. Photometry: The science of measurement of visible light in terms of its perceived brightness to human vision. Photogrammetry: Determination of the 3D coordinates of the points on an object by using 2D images taken from different locations and orientations.

2- Photogrammetry can be easily used in small scale lab measurements performed in the controllable environments but infield tests have their own specific problems. For example, the authors mention about the accuracy of the device they used (Leica Nova MS50). The proposed accuracy is 0.035 mm in x and y directions and 1mm in z direction. However, this accuracy can never be reached in the field. It is not related to the accuracy of the device. In the field, the target will never be at standstill, it will be vibrating continuously. Even at low wind speeds the vibration amplitude can be +/- 10-20 cm. Besides, due to the mean wind speed, this vibration will not be a zero average vibration. How can you claim that you will reach 1 mm accuracy if the target itself is vibrating +/- 10-20 cm.

3- Leica Nova MS50 or similar total stations can only take measurement at one point at a time and then they move to the next data point. Therefore, it takes quite a lot of time to take measurements on 35 reference points. Could you please make an estimation related to time required to take measurements at 35 or maybe 100+ reference points? How can you guarantee that the wind speed so the vibration will not change within this period?

4- During the calibration at the site, how are you going to rotate the blades manually by a specific angle step by step? How are you going to move the device from one point to another and how are you going to guarantee that the physical conditions, blade pitch angle or yaw angle or wind speed (so the amplitude of the vibration) will be constant. These conditions can easily be fulfilled in a lab environment but not at the field. Under

these circumstances bundle adjustment method is the only possibility because you take measurements at all the points simultaneously. The method you proposed may provide a higher accuracy in lab environment where calibration is performed in an isolated room where there is no wind but not in the field where there is always some sort of wind and noisy vibration.

5- The extrinsic calibration values are valid only for a certain yaw and pitch angle. During the rotation these values do change continuously, and then you will have to re-calibrate the system by using the new values. Are you planning to stop the turbine and to take some new calibration measurements with Leica system? You should explain in more detail how this method will be applied to the in-field tests?

6- Illumination is always the most important problem. That is why the markers you propose can only be used for close range of photogrammetry. For long range measurements, using reflective markers is the only choiceto reach the sufficient contrast levels. In the text page 14 line 20 you wrote that matt markers should be used. This suggestion makes the situation even worse, for long range measurements the markers should be as bright as possible to increase the contrast, otherwise the markers cannot be seen from long distances.

7- Page 2 line 5 ‘’the transducers load the structure with their weight that changes the dynamic properties of the structure and need expensive correction”. This statement is correct only if you perform some tests on very small models. I agree that an accelerometer of 100 grams can be considered as an added mass for a small scale model but weight of a real wind turbine or a real bridge is not affected by the weight of an accelerometer of 100 grams. Could you please remove this sentence?

8- P2 line 23 ‘’is” should be ‘’are”

9- P8 line 5 please change ‘’angel” to ‘’angle”

10- Page 11 line 13: You wrote that rotational speed of 30 rpm can cause an elongation

on metal rod blades. Could you please check these values again? I am not sure but I do not think that such a low speed can cause a noticeable elongation on metal rods?

11- Page 16: It is not clear how to read and interpret Table 1. Could you please explain in more detail what the distance between the light rays is? A sketch would be very helpful.

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