Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2020-94-AC2, 2020

Interactive comment on "Characterization of the unsteady aerodynamic response of a floating offshore wind turbine" *by* Simone Mancini et al.

Simone Mancini et al.

simone1.mancini@mail.polimi.it

Received and published: 27 September 2020

Dear referee,

sorry for the late reply and thank you for your interesting remarks on behalf of all the authors. I will try to reply to all the points hoping to dispel any doubt or concern.

Starting from the major comment, I understand your point and I recognize that the wind tunnel signals filtering procedure and its consequences have not been clarified enough. As you have noticed, a relevant harmonic component around 4Hz is indeed present in the spectrum of the experimental thrust oscillation shown in Fig.7a (its PSD is in attachment as Fig.1). However, there are strong evidences suggesting such peak to be due to an interference with the electric motor of the nacelle. In fact, such harmonic is

present in all the tests and corresponds to the rotor's revolution frequency (1P), which is similar to the second surge harmonic only in case 59 (see also the PSD of test 53 in Fig.2). Its amplitude appears rather independent on the surge parameters. Furthermore, this component is only captured by the ATI balance on top of the nacelle, whilst it is almost absent in both the accelerometer signal (also on the nacelle) and the RUAG balance measurement (at the tower base). In the surge tests with steady rotor (NOW) this harmonic is not present, while a small peak at the tower's first bending mode is always observable around 6 Hz, although in the SIW case it is strongly smoothened by the aerodynamic damping. The ATI balance measurements for the cases 53 and 59 are Reported in Fig.3. It is evident that the peak at the surge frequency is dominant and the only reason why the others become so important in the aerodynamic thrust is that the inertia subtraction procedure only works at the surge harmonic. The other frequency components could even be amplified subtracting inertia with Eq. 2 (depending on the phases). Therefore, after the inertia subtraction the only meaningful signal becomes the one at the surge frequency.

Despite a 1P harmonic may also be triggered by aerodynamic effects, its insensitivity to the surge parameters together with the lack of a corresponding peak in the accelerometer measurement suggest that it might have been just a disturbance, likely from the electric motor. The absence of such harmonic in all the numerical results further confirms this hypothesis. In fact, the high fidelity CFD models are expected able at least to capture the unsteady aerodynamic effects, albeit with moderate accuracy. Finally, there is no trace of significant 1P harmonics in the literature data as well.

About the eventuality that the numerical models may not be able to capture phenomena observed in the experiments I deem it very unlikely. In our case the only relevant assumption common to all the codes is the modelling of the turbine as rigid. However, the modal analysis conducted on the scaled turbine suggests that if some unmodelled aeroelastic effect occurred, it would occur at higher frequencies than 1P.

Such an in-depth analysis of the wind tunnel tests does not fit the scope of the paper under review. Nevertheless, some more comments will be added in hope to clarify the reasonable remarks that you made.

The choice to focus on the surge motion was made for the great advantages it gives in terms of kinematics. Being the first experimental campaign featuring such a level of detail, it was wisely decided to start from the easiest case, which has revealed not so easy anyway. Of course, the topic of pitch remains of paramount importance and it will be hopefully addressed in future work.

In the revised version I will try to put some more emphasis on the platform motions, a bit shortening the part on control.

About the names RATED1 and RATED2 I confirm what written in the previous reply.

Concerning the lifting line comment in line 175, this point can be subject to debate as all BEM codes condense the blade to a lifting line and treat the wake using momentum theory. As such, it makes use of lifting line variables as 2D airfoil coefficients and induction. To prevent confusion the sentence has been reformulated anyway.

Section 3.1 gives a high-level overview of the available models. The actual models and effects relevant for the simulations in the paper are discussed in section 3.1.1 to 3.1.3. Sentences in section 3.1.3 will be added to provide extra info. Text will be also added to clarify the choice of the simulation parameters that had been validated before through a sensitivity analysis indeed.

In Section 3.2 the LES simulations settings are described. Being a free flow without BL (the wind tunnel walls are modelled as smooth), the Popes' criterion was verified by empirically estimating the integral length of the free inflow turbulence and choosing the mesh size accordingly. A similar comment may be added to the revised version as well.

Additional information about the modeling of the surge motions in the full CFD simulations will be added to Section 3.3.

Table 4 and Figure 7 will be adjusted following your suggestions.

The factor eˆ(i2πf_s t) has been implied in Eq. 6 and 19, but I agree that this should be specified.

I hope this answer will be enough to clarify your doubts, otherwise I remain available to provide you with additional data or comments. I will do my best to revise the use of English in the manuscript. Thank you very much for your review.

Yours faithfully,

Simone Mancini

Interactive comment on Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2020-94, 2020.

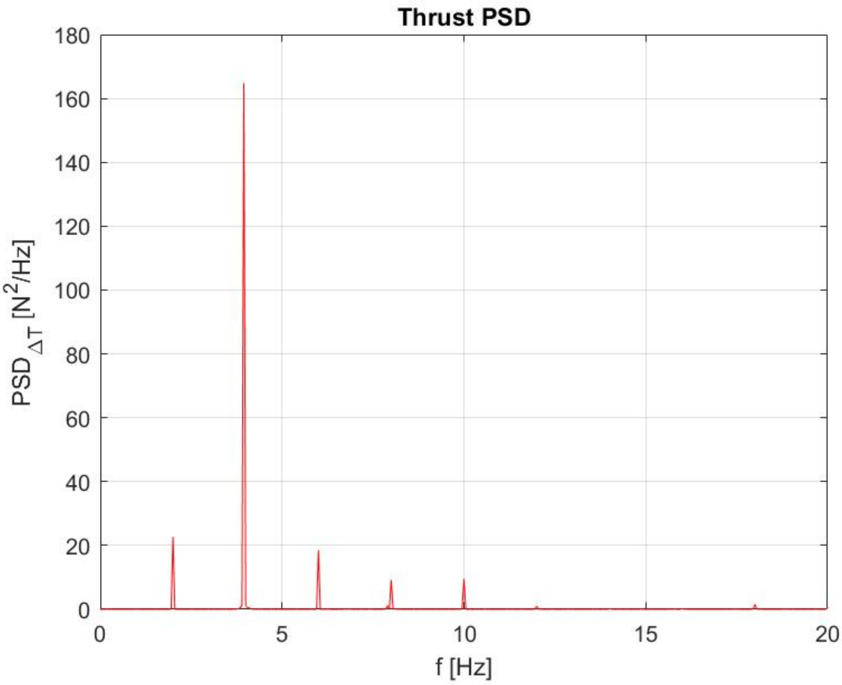
Thrust PSD
180
160
140
120
100
80
60
40
20
0
PSD$_{\Delta T}$ [N^2/Hz]
0
5
10
15
20
f [Hz]

Fig. 1.

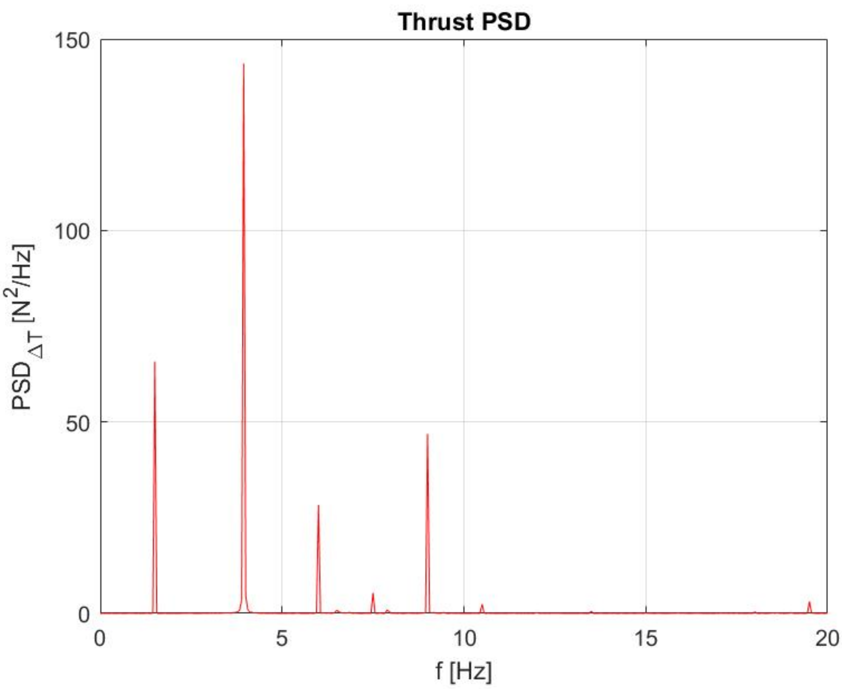
Thrust PSD
150
100
50
0
PSD$_{\Delta T}$ [N^2/Hz]
0
5
10
15
20
f [Hz]

Fig. 2.

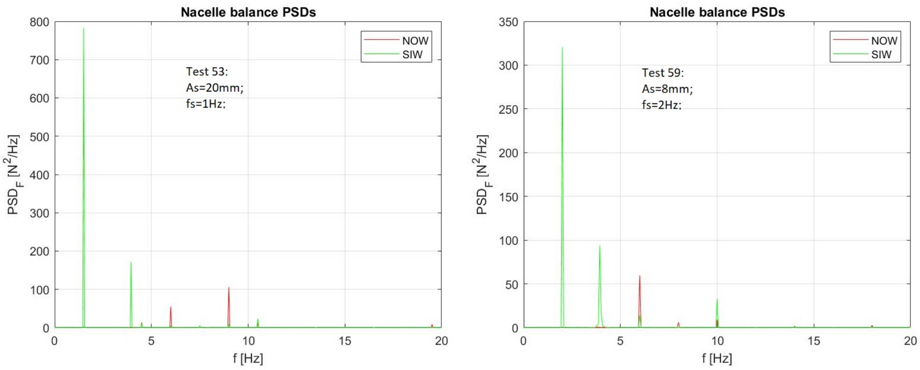
Nacelle balance PSDs
Test 53:
As=20mm;
fs=1Hz:
NOW
SIW
PSD$_F$ [N^2/Hz]
f [Hz]
Nacelle balance PSDs
Test 59:
As=8mm;
fs=2Hz:
NOW
SIW
PSD$_F$ [N^2/Hz]
f [Hz]

Fig. 3.