Wind Energ. Sci. Discuss., author comment AC1
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Reply on RC1

Felipe Vittori et al.

Author comment on "Model tests of a 10 MW semi-submersible floating wind turbine under waves and wind using hybrid method to integrate the rotor thrust and moments" by Felipe Vittori et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-148-AC1, 2022

Dear Referee RC1,

On behalf the authors of this work we appreciate your time and the comments about our work.

In this work we want to highlight two main outcomes. The first one is that we have tested a new feature in the SiL hybrid method: including the wind turbine moments (not only the thrust). Due to this improvement, the platform response in yaw, induced by the wind turbine out-of-plane moment around the vertical moment “Mz” was obtained. In the subsequent validation of the numeric model in OpenFAST of the SATH 10MW model in full scale it was observed a good agreement between numerical results and experimental measurements of the platform yaw response under the same wind and wave conditions. This shows the good performance of the new feature of the SiL method.

The second relevant outcome is related with a variation of the platform pitch natural frequency obtained in the experiments under high rotor thrust, compared to the natural frequency obtained in free decays. This variation is caused by a change of the hydrostatic stiffness when the platform tilts. During validation of numerical model it was observed that OpenFAST was not able to capture this variation in the natural frequency. The reason is that OpenFAST assumes a linear behavior of the hydrostatic stiffness matrix that is obtained at the un-displaced platform position. Nevertheless, the complex geometry of SATH platform produces a highly non-linear behavior of this stiffness. For this reason, once the stiffness matrix was recomputed for the tilted platform, the pitch natural frequency of the computation agrees with the experiments.

This limitation of the common linear potential hydrodynamic numerical model is an open issue. A better computation of the instantaneous buoyancy loads may improve the simulation of dynamic response of a FOWT with this type of floater geometry.

We have updated the document considering all your comments to highlight the scope of this article and we have listed some of the clarification below:

- For these experiments the tower for the scaled model was designed rigid, with a larger diameter to avoid any elastic response and reduce uncertainties.
- In this test campaign the SPM system was not implemented to ease the uncertainties

on the initial validation of the numerical tools and floating design. The retention system constrains all the platform degree of freedom. In contrast, once the SPM is enabled, the platform will be able to freely rotate in yaw offering a different dynamics of the platform.

- The mooring system was modelled using a stiffness matrix (6x6) in Hydrodyn with coupled terms at the respective DoF. First, the matrix coefficients were defined mathematically and afterwards the coefficients were tuned according to the platform response in the free decays.
- A 3% of difference in platform pitch stiffness due to the cable bundle was estimated from experimental pitch free decays with and without cable bundle. The numerical model takes into account this effect by including an additional pitch stiffness coefficient.
- We have discarded that the difference in the PSD peaks are caused by low frequency 2^{nd} order effects because this difference also appears at the turbulent wind only cases. Thus, we believe that the difference in PSD peaks are related with uncertainties in the characterization of the couplings of the retention systems.