Reply to Reviewers' and Editor's Comments

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Effect of scour on the fatigue life of offshore wind turbines and its prevention through passive structural control

By Yu Cao, Ningyu Wu, Jigang Yang, Chao Chen, Ronghua Zhu, Xugang Hua

Overall Response:

We are very grateful to the Editor and Reviewers for their constructive comments on this manuscript once again. We have further revised and improved the manuscript based on the comments and clarified the issues brought up in the paper. In the following sections, point-by-point responses to the comments were provided. The original comments are in italics. The authors' responses are highlighted in blue. The corresponding changes are highlighted in red in the revised manuscript.

Reviewer #2

Comment 1: *Previous comment no. 7: Could you please add the matrices* $\boldsymbol{C}_T = \begin{bmatrix} 0 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & c_T \end{bmatrix}$ *etc. to the manuscript. In your answer, the definition of* $\boldsymbol{C}_T$ *it is very, but in the manuscript, it can still be improved.*

Response: Thank you for your suggestion. According to your comments, the authors have further added the formulations of the matrices $\boldsymbol{C}_T, \boldsymbol{K}_T, \boldsymbol{U}_S$ and vector $\boldsymbol{U}_T$ in the original manuscript.

Revised manuscript:

L122-L126: where $\mathbf{M}_S$, $\mathbf{C}_S$, $\mathbf{K}_S$ are the mass, damping and stiffness matrices of the main structure. $\mathbf{C}_T, \mathbf{K}_T$ are matrices with same dimensions containing c_T, k_T , $\mathbf{C}_T =$

$\begin{bmatrix} 0 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & c_T \end{bmatrix}$, $\mathbf{K}_T = \begin{bmatrix} 0 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & k_T \end{bmatrix}$. $\mathbf{U}_s$ is the displacement vector of the main structure, $\mathbf{U}_s = \begin{bmatrix} u_{s-1} \\ \vdots \\ u_{s-top} \end{bmatrix}$. $\mathbf{U}_T$ is the displacement vector containing u_T, $\mathbf{U}_T = \begin{bmatrix} 0 \\ \vdots \\ u_T \end{bmatrix}$. $\mathbf{F}_{wind}$, $\mathbf{F}_{wave}$ are the aerodynamic and wave load vectors.

Comment 2: *Previous comment no. 10: In your answers, you nicely explain that and why you neglect the nonlinearity of the soil matrix. In the paper, it is only mentioned in the conclusions. Perhaps, you can add one more sentence to Section 2.3.?*

Response: According to your comments, the authors have added explanations about ignoring nonlinearity of the soil matrix in Section 2.3.

Revised manuscript:

L232-L236: where $\boldsymbol{K}_{soil}$ is the equivalent soil stiffness matrix, $\boldsymbol{u}_{soil}$ is the displacement vector, and $\boldsymbol{F}_{soil}$ is the reaction force vector. The equivalent soil stiffness matrix ignores the nonlinearity in the force-displacement relationship. This approach is suitable for fatigue analysis, as in normal operation conditions the deformation of the soil around the monopile is relatively small and the nonlinearity in soil stiffness is very weak.

Comment 3: *Previous comment no. 13: According to the reference paper "t is the thickness through which a crack will most likely grow. And $t = t_{ref}$ is used for thickness less than t_{ref}. In fact, when t is more than t_{ref}, t is the actual thickness of the pile." In your case, $t > t_{ref}$. Hence, t is the actual thickness of the pile. I suggest adding this to the manuscript.*

Response: According to your comments, the authors have added more details of the value of t in the manuscript.

Revised manuscript:

L282-L288: where N is the number of cycles to failure, $\Delta\sigma$ is the stress range. $\Delta\sigma$ is calculated from the nominal stress $\Delta\sigma_{nominal}$ by the equation $\Delta\sigma = SCF \cdot \Delta\sigma_{nominal}$, SCF is the stress concentration factor. m is the negative inverse slope of the S-N curve, and $log\bar{a}$ is the intercept between the log N axis and the S-N curve, t_{ref} is the reference thickness for welded joints, t is the thickness at which cracks may grow. *And $t = t_{ref}$ is used for thickness less than t_{ref}. When t is larger than t_{ref}, t is the actual thickness of the pile.* k is the thickness exponent of fatigue strength.

Comment 4: *Previous comment no. 15: In your answers, you explain that N_c is obtained by the rainflow counting algorithm in MATLAB. As the reader might not know this, you should add an explanation how N_c is obtained to the manuscript.*

Response: According to your comments, the authors have added an explanation for how N_c is obtained.

Revised manuscript:

L**295**-L**300**: where $\mathbf{N_c}$ is the total number of bins obtained by rainflow counting, $\mathbf{n_i}$ is the number of cycles in stress range **i**, $\mathbf{N_i}$ is the number of cycles to failure in stress range **i** , and $\mathbf{D_k}$ is the total fatigue damage index. The "rainflow" function in MATLAB is adopted for rainflow counting. When a stress time history is given, this function can automatically obtain the i^{th} stress range and the corresponding cycle number n_i, and N_c is the total number of stress ranges.

Comment 5: *Previous comment no. 17: You comprehensively explain the reason for putting the TMD in the tower. I think that this explanation is not required to be repeated in the manuscript. Nonetheless, in the manuscript, it should be pointed out that the TMD could/should be rotatable as well (second last sentence of your explanation in the answers).*

Response: Thank you for your suggestion. According to your comments, the authors have added an instruction about the TMD can be rotated in the tower to the manuscript.

Revised manuscript:

L321-L323: Therefore, the TMD is installed inside the steel tube at the tower top to mainly control the vibration in the FA direction, as shown in Fig. 5. And the TMD is aligned with the FA direction by rotating the damper.

Comment 6: *Previous comment no. 24: You give a description of the difference between the modelling of operating and parked conditions in the answers. However, none of the explanation is added to the manuscript. Perhaps, you add the most important points of it to the manuscript as well*

Response: Thank you for your suggestion. According to your comments, the authors have added an explanation of the difference between the modelling of operating and parked conditions to the manuscript.

Revised manuscript:

L379-L386: In this study, fatigue analyses are performed under 22 environmental states provided by Tempel (2006), taking into account both operational and parked conditions. These 22 environmental states are shown in Table 4. In operating conditions, the wind turbine bears the aerodynamic load of the rotating rotor and the wind load of the tower, and the wind load on the rotor is calculated using the BEM theory. In parked conditions, the wind turbine mainly bears the aerodynamic load on the tower, and the aerodynamic damping is very small. The aerodynamic loading on the blades is calculated by directly looking at the aerodynamic loading coefficient table given the local attack angles.