Numerical wave tank analysis of the Oscilla Power Triton device

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Abstract

A design response analysis for the Oscilla Power Triton wave energy converter (WEC) [1] was performed using both a mid-fidelity model (Orca-Flex) and a high-fidelity "numerical wave tank." The numerical wave tank comprises a computational fluid dynamics (CFD) model with a rigid-body dynamics model to accurately resolve the wave-body interaction. Due to the computational expense of executing CFD models, two types of representative design waves (see, e.g., [2]) were utilized to approximate the worst-case loading in realistic irregular seas: regular waves [3], in which the wave height is roughly double that of the significant wave height from the target sea state, and focused waves [4], in which a transfer function from the response of interest is used to construct an ensemble of focused wave components.

A rendering from a regular design wave CFD simulation with $H = 9.0\,\mathrm{m}$ and $T = 9.2\,\mathrm{s}$ is shown in Figure 1. Response time histories for this same simulation are shown in Figure 2. In this wave, which represents a design loading case for the tethers that connect the float and subsurface reaction ring, the CFD simulation predicts maximum tensions in the port and forward tethers of 6.4 MN and 8.3 MN, respectively. This compares well with the Orca-Flex model, which predicts corresponding maximum tether tensions of 6.7 MN and 8.5 MN, for the port and forward tethers respectively, in a long-duration irregular sea.

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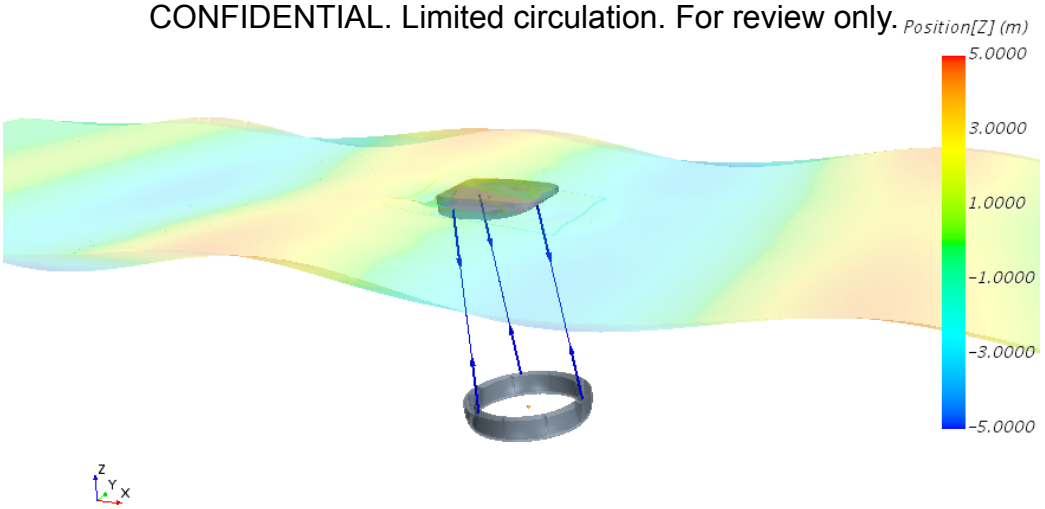

Figure 1: Rendering from regular wave case ($H = 9.0\,\mathrm{m}$ and $T = 9.2\,\mathrm{s}$) at $t = 60\,\mathrm{s}$.

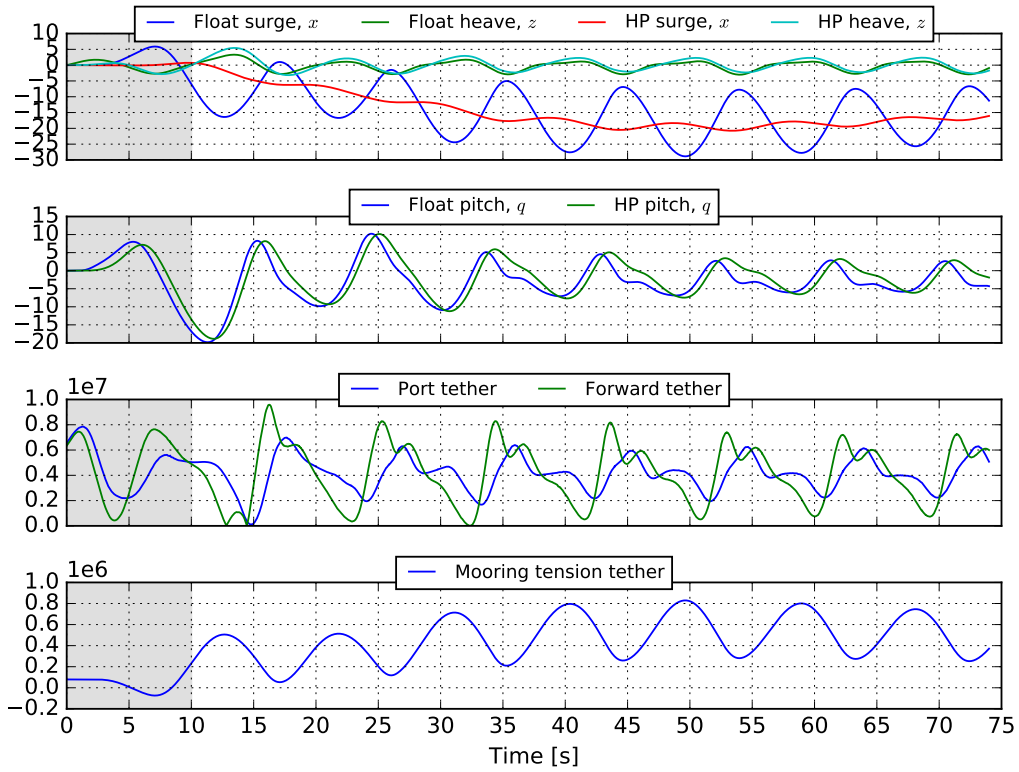

Figure 2: Regular wave case ($H = 9.0\,\mathrm{m}$ and $T = 9.2\,\mathrm{s}$) responses. Note that the gray region ($0 \leq t \leq 10\,\mathrm{s}$) indicates dynamics ramping. All plots use the same time axis. Positions in $[m]$, rotations in $[°]$, forces in $[N]$.

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References

[1] Mundon, T. R., Rosenberg, B., and Van Rij, J., 2017. "Reaction body hydrodynamics for a multi-DOF point absorbing WEC". In Proceedings of the 12th European Wave and Tidal Energy Conference (EWTEC2017).

[2] Coe, R. G., Yu, Y.-H., and van Rij, J., 2018. "A survey of WEC reliability, survival and design practices". *Energies,* ***11***(1), p. 4.

[3] NORSOK, 2007. Actions and action effects (n-003), September.

[4] Quon, E., Platt, A., Yu, Y.-H., and Lawson, M., 2016. "Application of most likely extreme response method for wave energy converters". In 35th International Conference on Ocean, Offshore and Arctic Engineering (OMAE), ASME.

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