AN ANALYSIS OF FLOATING WIND TOWING OPERATIONS USING OPENFAST

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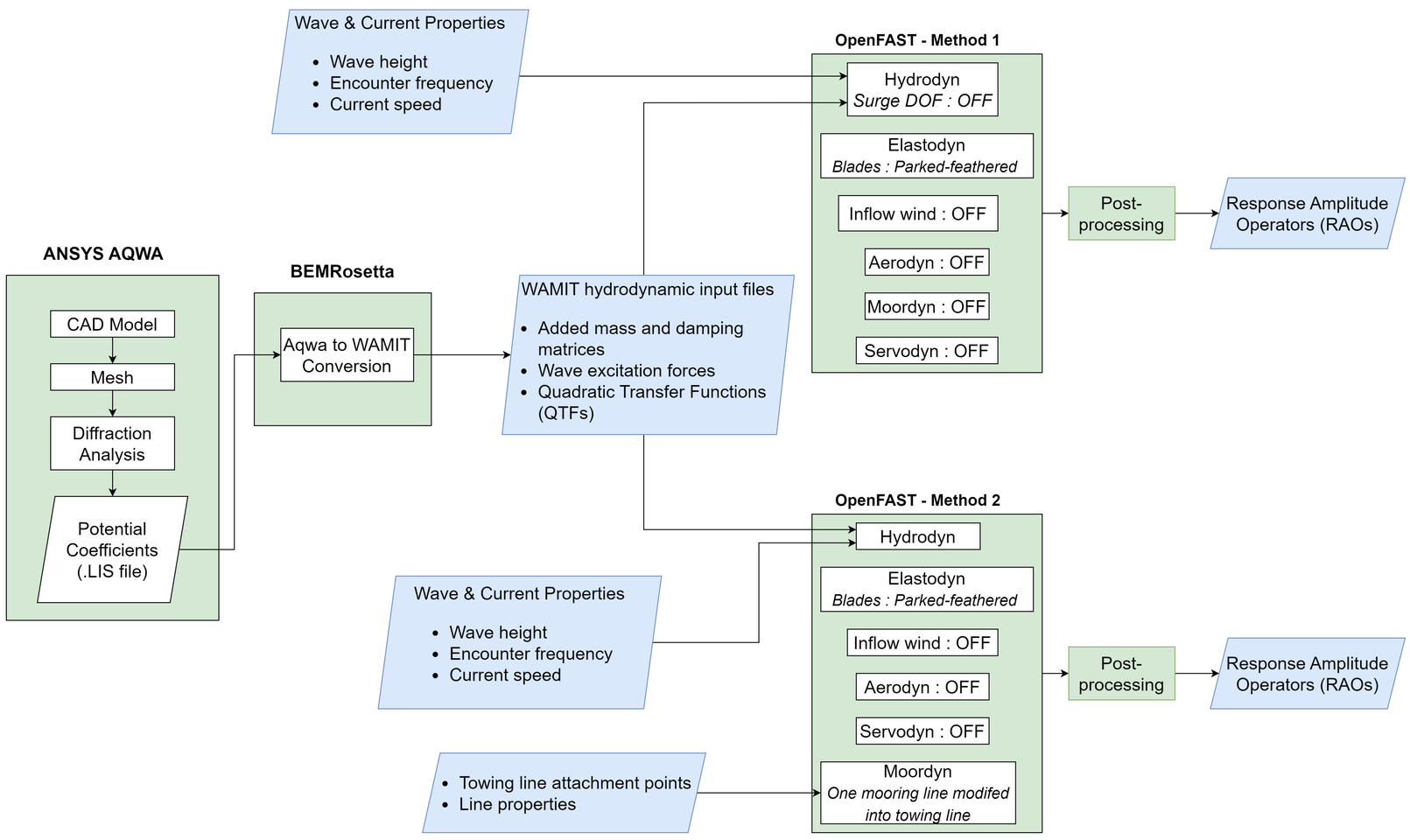
IMPORTANCE OF TOWING OPERATIONS

The floating wind industry is slowly entering the commercialisation phase and array-scale floating wind farms are imminent. Irrespective of the type of floater used, towing operations represent a crucial marine activity required during installation, major repairs and decommissioning phases. Numerical analysis of towing operations is vital for predicting hydrodynamic motions and towing loads, enabling the identification of metocean limits crucial for achieving optimised safe and efficient execution. This study introduces a novel approach for analysing floating wind turbine towing operations using OpenFAST. Generally, OpenFAST is used for the aero-hydro-servo-elastic simulations of wind turbines in installed conditions. Using the new approach towing simulations were performed using OpenFAST and the results are compared against data obtained from an experimental campaign.

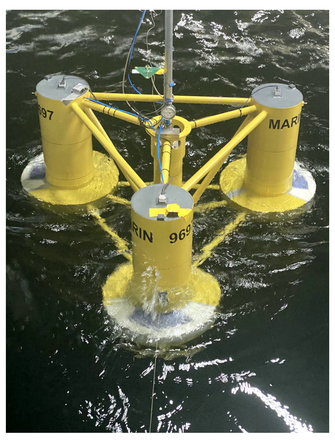
HOW TO USE OPENFAST FOR TOWING SIMULATIONS

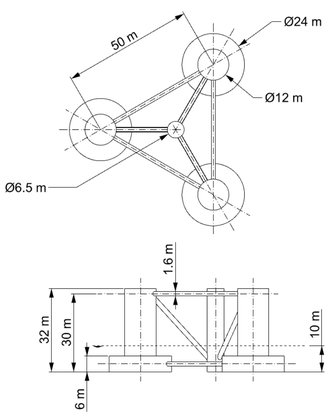
Towing can be simulated in OpenFAST by inducing a forward-speed effect on the towed platform.

- By constraining the FOWT (Floating Offshore Wind Turbine) system and applying a current, which has a speed equal to the speed of towing.
- This FOWT can be constrained by using two different methods :
  - Method 1 - By setting the surge DOF (Degree of Freedom) to zero
  - Method 2 - By modifying a mooring line into a towing line
- Replacing the wave frequencies with encounter frequencies to include the forward-speed effect.

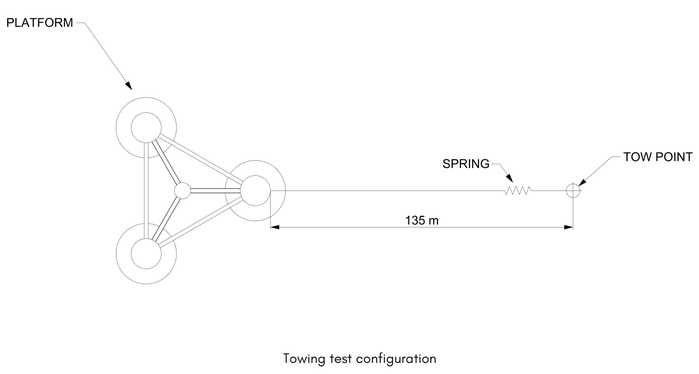


EXPERIMENTAL VALIDATION

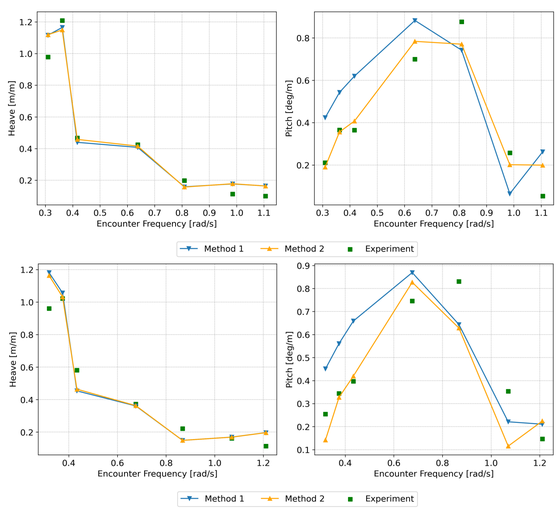




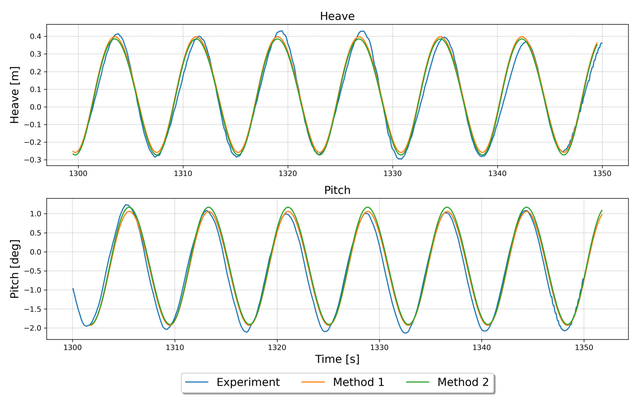
Platform Model: DeepCwind semi-submersible (5 MW) [1]



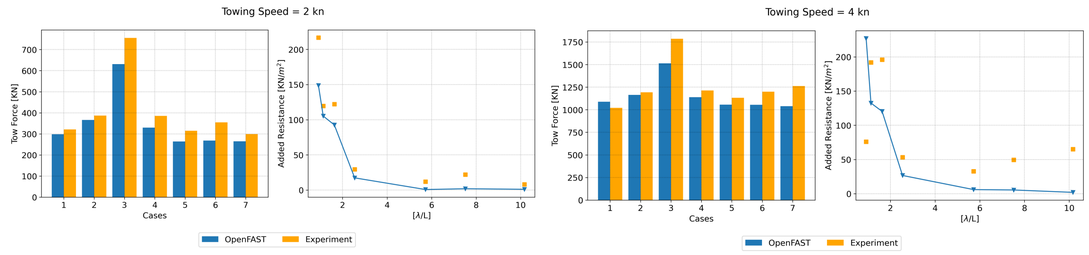
Towing test configuration



Motion RAOs, Towing speed 2 kn (Top) 4 kn (bottom)



Time-domain validation example, Wave height = 4 m, T = 8.38 s, Towing speed = 2 kn



Towing forces and added reistance in waves, Towing speed 2 kn (Left) 4 kn (Right)

CONCLUSIONS

- OpenFAST (Method 2) can predict heave and pitch RAOs with good accuracy.
- Method 1 makes good predictions of heave but pitch predictions need to be improved.
- The towing loads were also predicted by OpenFAST (Method 2), slightly underpredicting by about 13% and 9% for 2 kn and 4 kn towing speeds respectively.

References:
[1] Robertson, Amy, et al. Definition of the semisubmersible floating system for phase II of OC4. No. NREL. National Renewable Energy Lab.(NREL), Golden, CO (United States), 2014.

STEP WIND
Training network in floating wind energy

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