

A study of Squid Wave Energy Converter with CFD and experimental approach

Introduction

- Means of renewable energy have raised our attention to overcome energy crisis. Ocean waves have a large resource and wave energy converters (WEC) are one of the most popular ways to harvest this energy
- Numerical modelling of WECs by CFD approach can precisely predict device response to large waves in relation to power performance and survivability of the device .

Numerical Aims

- Combined CFD (OpenFOAM) and multi-body dynamics (MBDyn) approach^[1] to model the Albatern 12s Squid.
- Hydrodynamic loading, dynamic responses, wave structure interaction are fully examined.
- Numerical results will be validated against experimental tank testing results.

Experimental Data

- Wavetank test of Alabtern 12s Squid.
- Testing performed at 1:18 scale
- Regular and irregular wave test performed with a range of power-take off linear damping values
- Qualysis used to capture motions

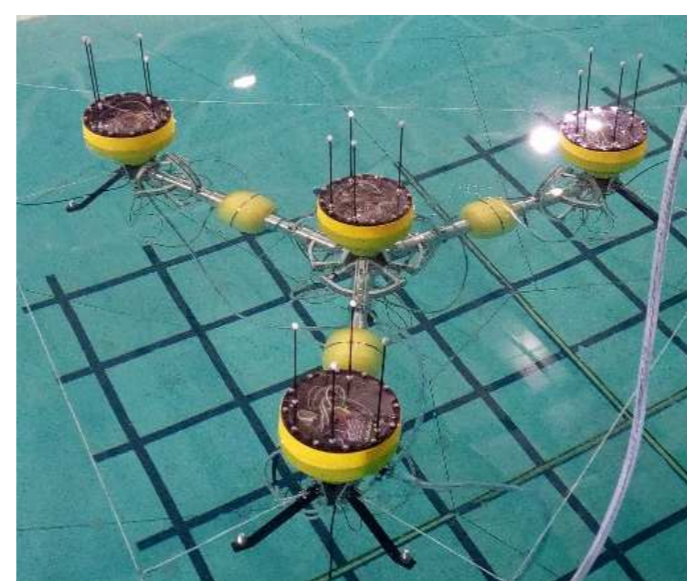
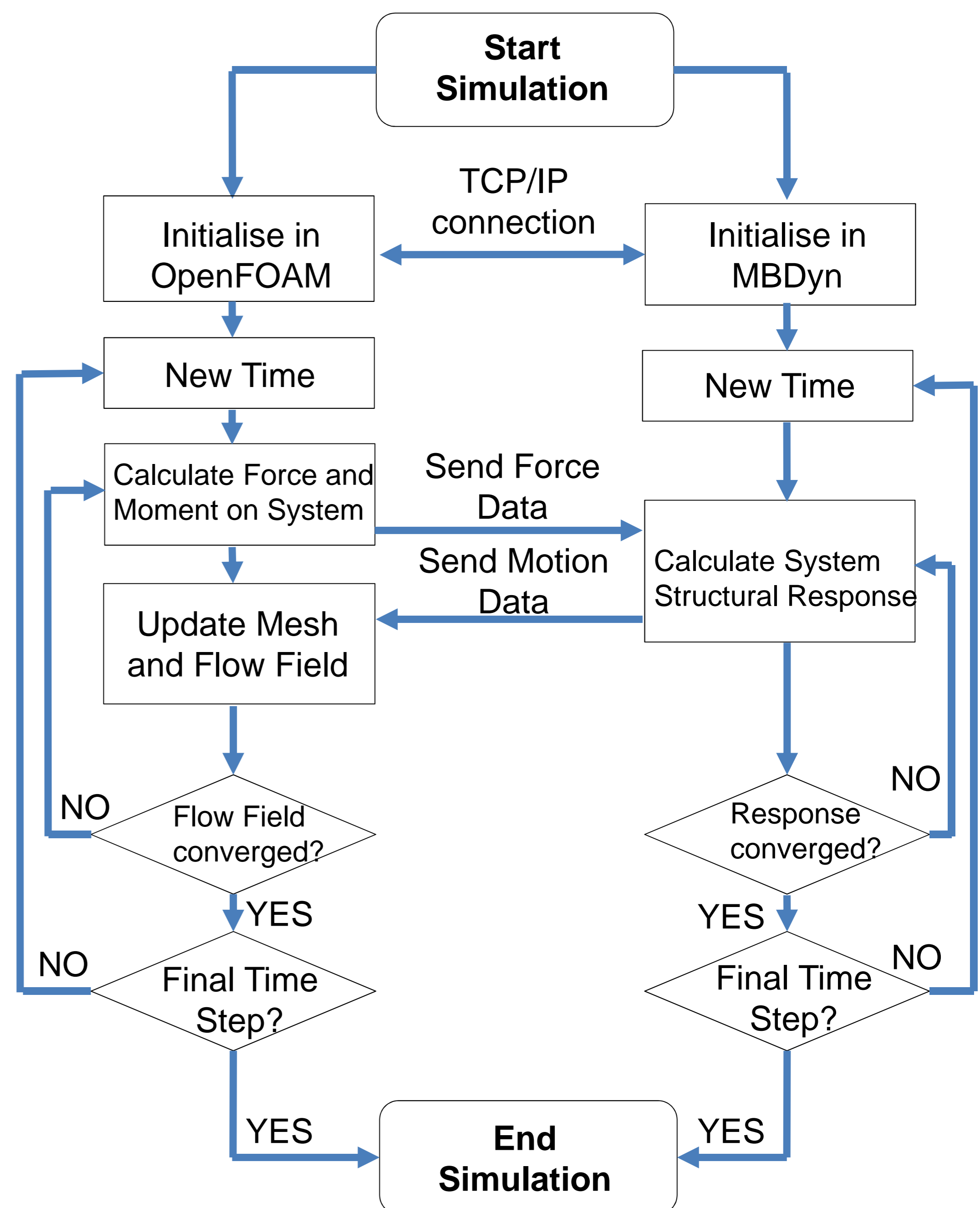


Figure 1: Albatern 12S Squid 1:18 scale model in wave tank

Numerical Method



Results

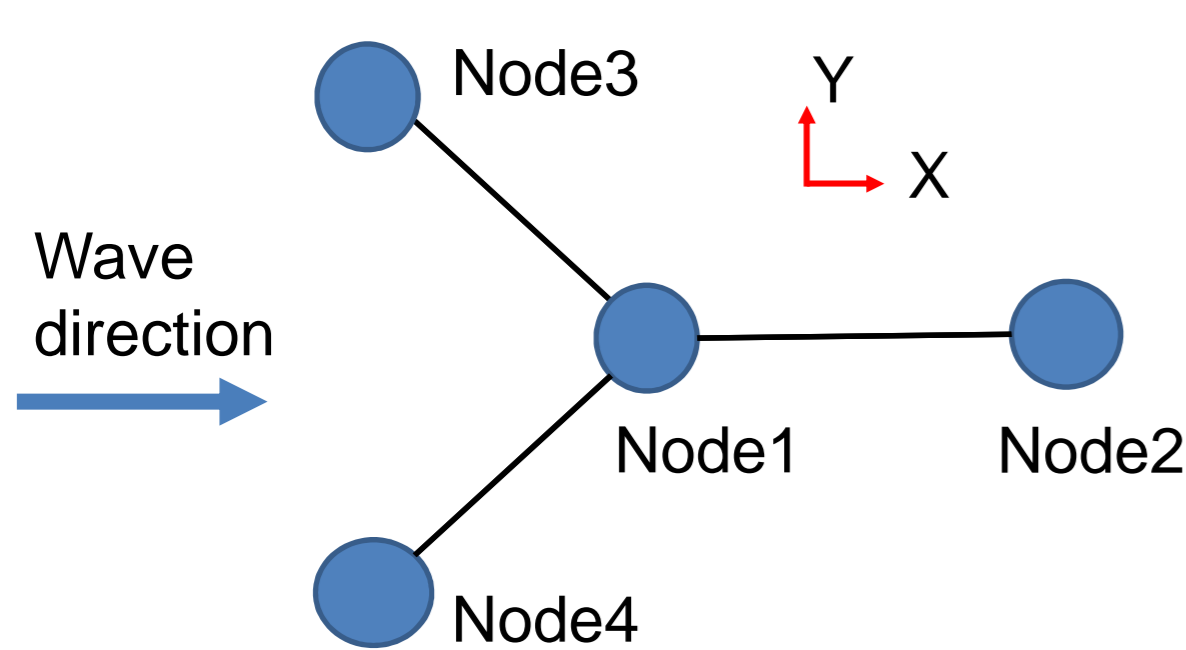


Figure 2: Model description of Squid

- Link arm is not included in CFD-MBD solver, represented by constraints.
- Free rotational motion but co-located as a ball joint used between nodes.
- Constraint used to add additional stiffness between adjacent nodes.

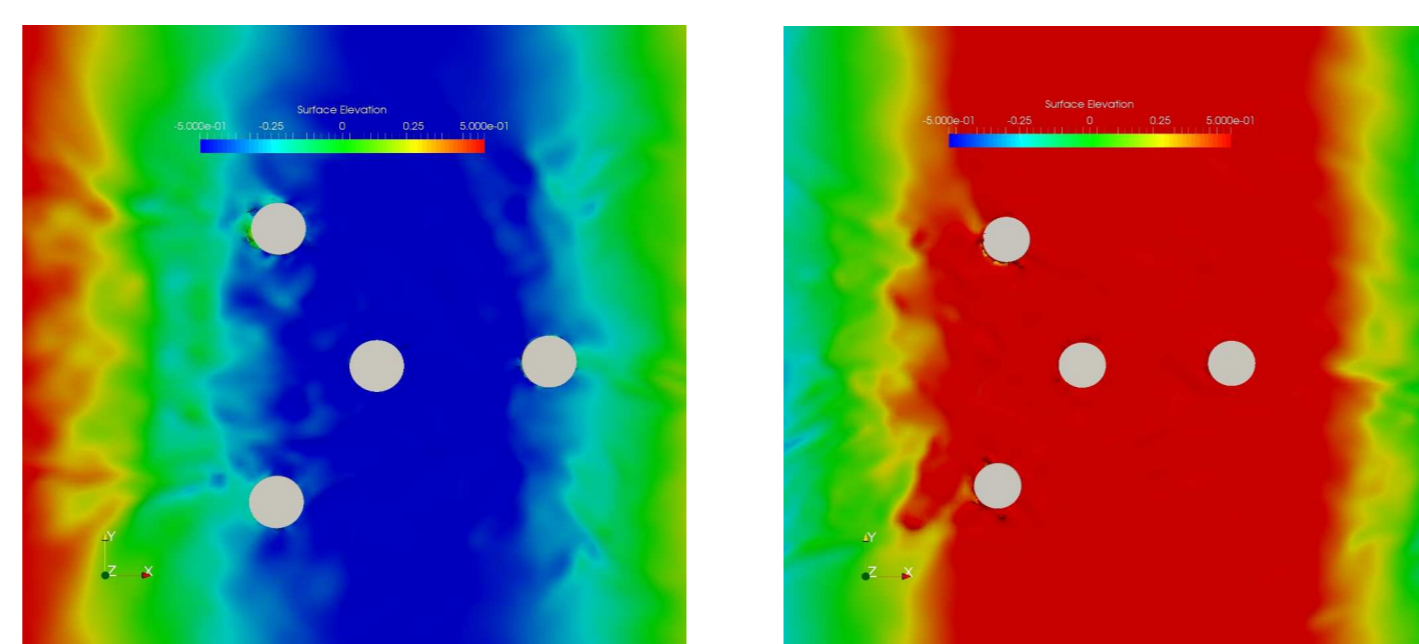


Figure 3: Surface elevation around squid at Time 100s(left) and 105s(right) (T=9.5s, H=1.5m)

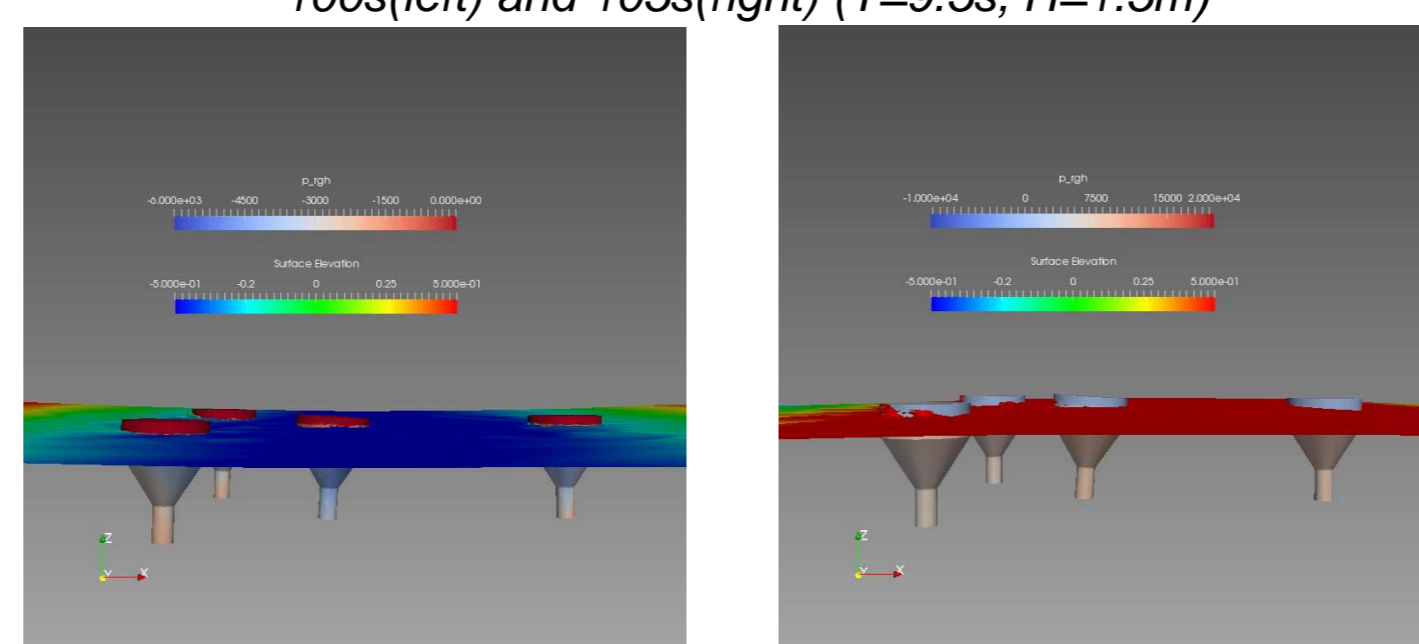


Figure 4: Relative motions of squid at Time 100s(left) and 105s(right) (T=9.5s, H=1.5m)

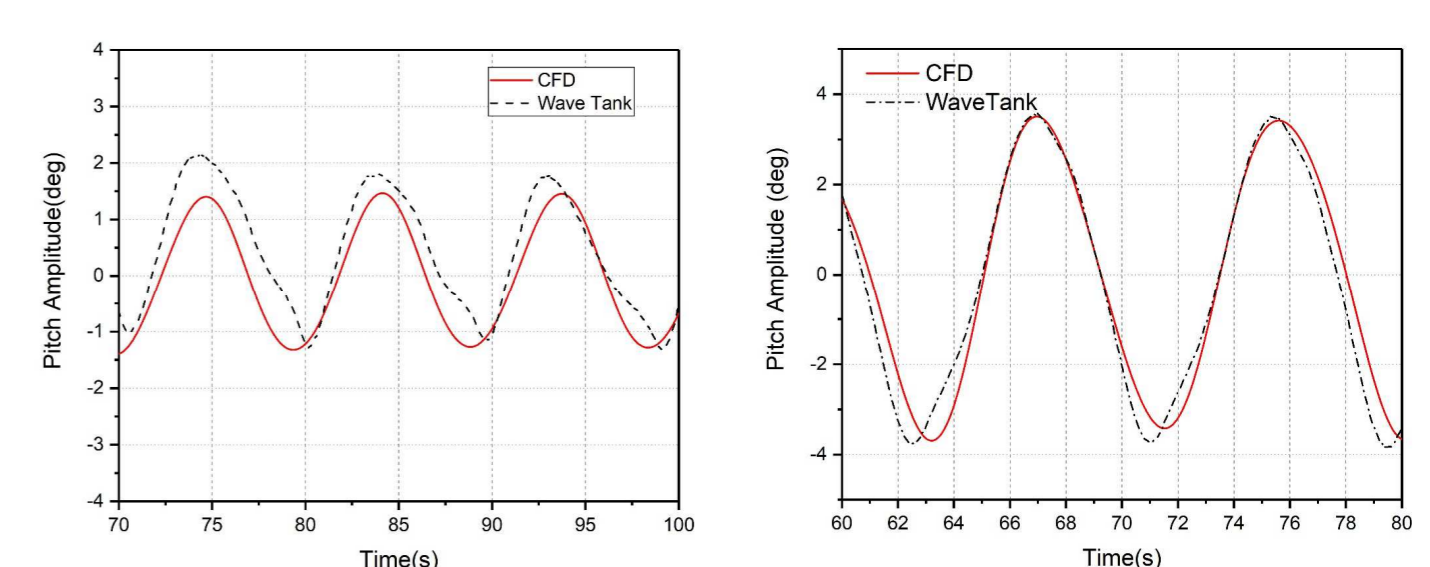


Figure 5: Pitch amplitude results compared with wave tank test at T=9.5s, H=1.5m(left) and T=8.5s, H= 1.5m(right)of Node2

- Initial results show promising comparison of calculated and experimental displacement of the nodes in pitch.
- Pitch motions get larger as wave frequency is closer to the nodes natural frequency.

References

[1] Liu, Y., Xiao, Q., Incecik, A., & Peyrard, C. (2018). Aeroelastic analysis of a floating offshore wind turbine in platform-induced surge motion using a fully coupled CFD-MBD method. *Wind Energy*. doi:10.1002/we.2265