# Investigating the effects of nonlinear hydrodynamics and breaking waves on mooring line loads for floating offshore wind turbines

*HYDROMORE: HYDROdynamic Mooring analysis for Ocean Renewable Energy*

Ashlesh Sadashiv Sharma[1]; David Roger Lande-Sudall[1]; Carina Bringedal[1]; Peter Stansby[2]

[1]Western Norway University of Applied Sciences; [2]University of Manchester

## Background and Aim

The aim of this research is to establish improved best practice approaches in the design of mooring systems for floating offshore wind turbines. Given the inherently non-linear and dynamic nature of moored floating wind structures, our research utilises a coupled hybrid approach:

- Non-breaking wave events - we employ an efficient fully non-linear potential flow (FNPF) model,
- Wave breaking, which is not captured by FNPF methods, we employ a Lagrangian Smoothed Particle Hydrodynamics (SPH) solver.

Preliminary results showcased here are of extreme focused wave scenarios in REEF3D::FNPF.

## Focused wave groups in REEF3D::FNPF

The numerical investigation using REEF3D::FNPF module has attempted to recreate some experimental wave cases investigated in MarinLab[1] at HVL, originally performed by [2]. Extreme wave events are modelled as a focused wave group of 28 frequency components. A comparison of measured and modelled spectra for one breaking case is shown here:

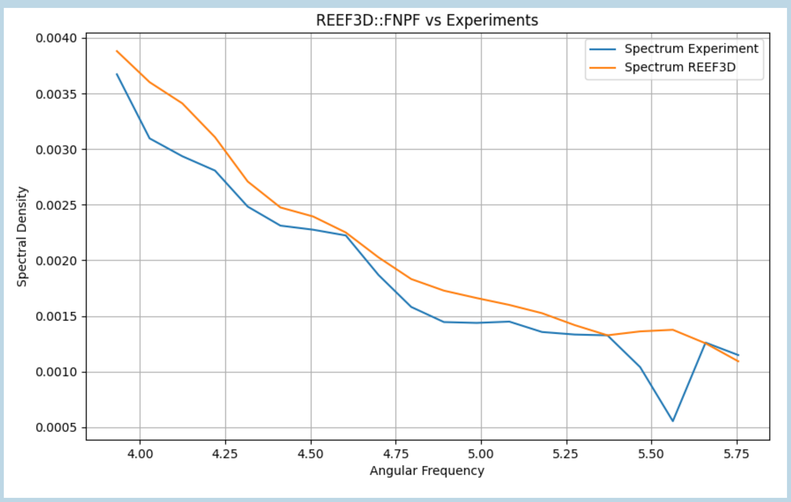



**Fig 1:** *Spectra for Amax = 151 mm, wave breaking case; as expected higher energy can be observed in FNPF model*

## Comparative results REEF3D::FNPF vs experiments:

- Good agreement for non-breaking wave groups,
- These breaking waves are being investigated using SPH
- Higher wave energy for breaking wave groups in FNPF.

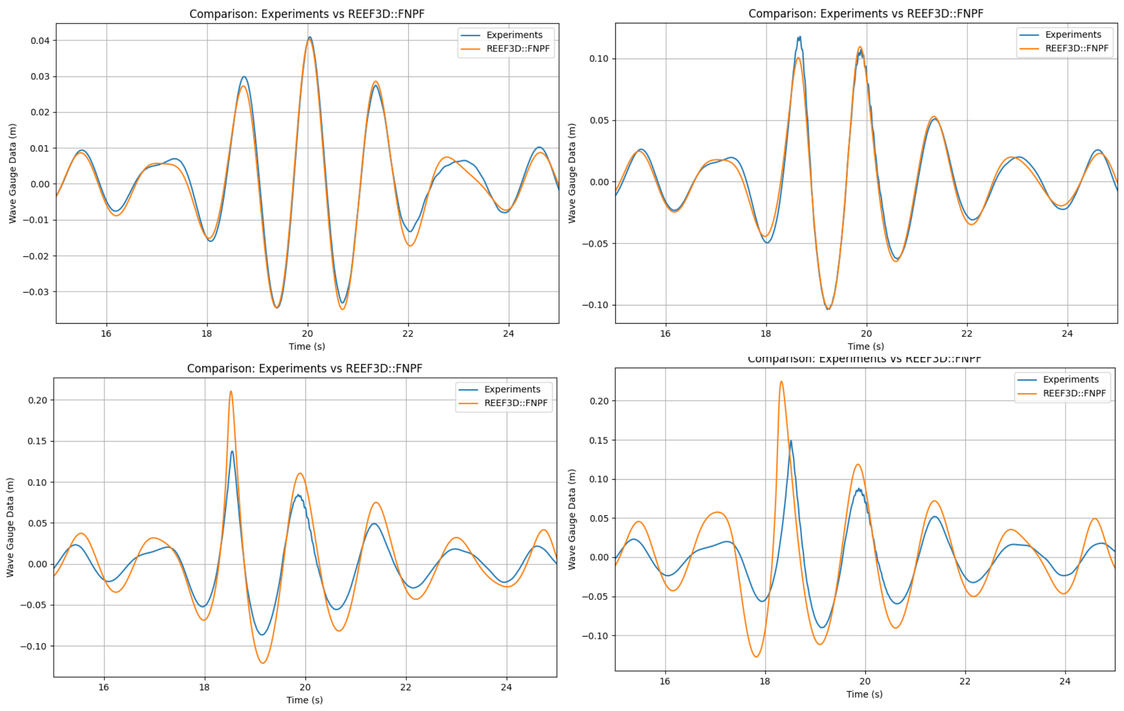
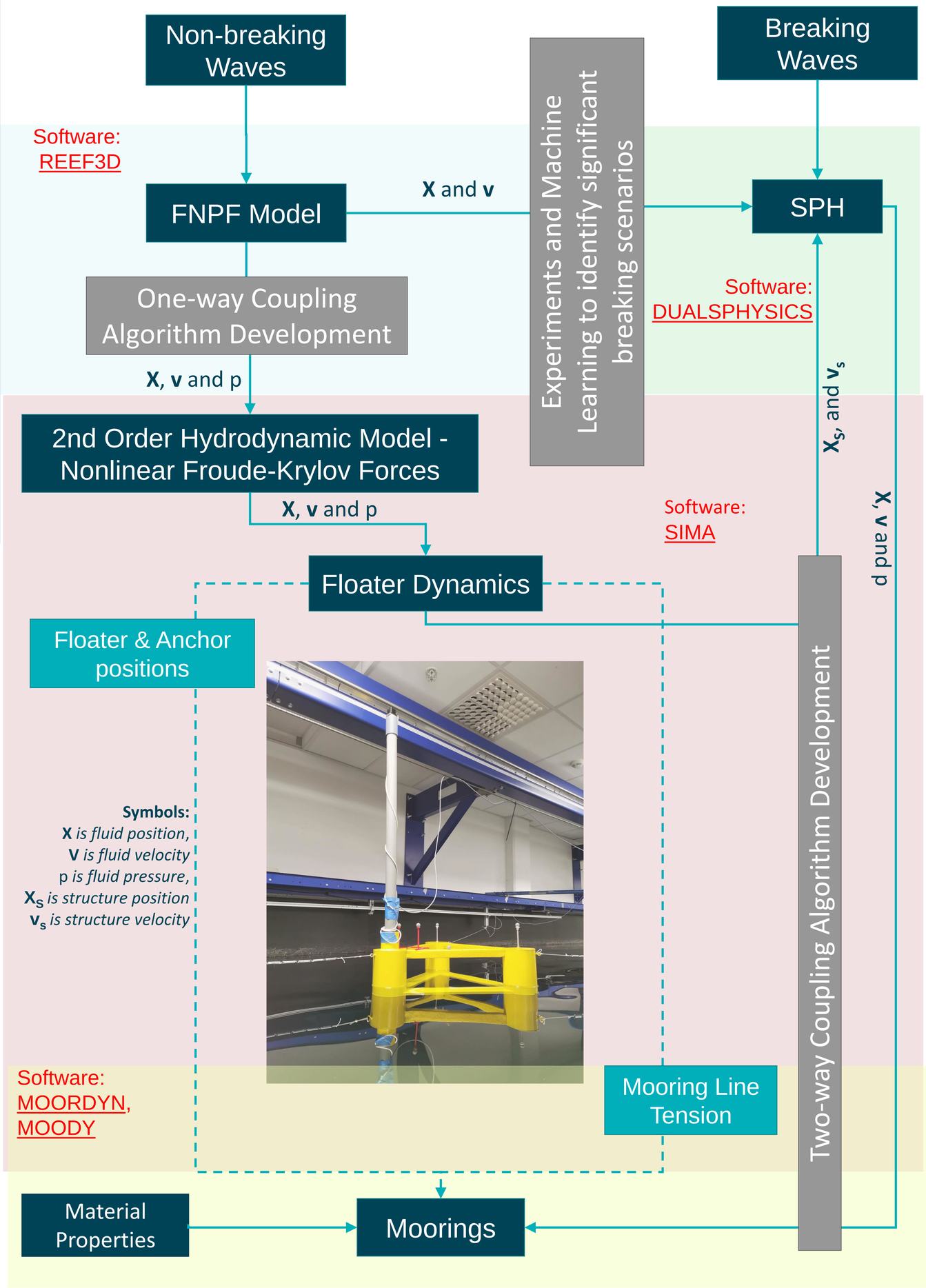



**Fig 1(L to R):** *Timeseries for (a)Amax = 37 mm, (b)Amax = 101 mm, (c)Amax = 151 mm and (d)Amax = 181 mm. Good agreement in linear cases((a)&(b)) while a sharp increase in focussed amplitude in wave breaking cases ((c)&(d)) is observed; drawback of FNPF model for wave breaking cases is evident here.*

## Current Research Overview




## References

[1] JG Kvamme, Eksperimentell og numerisk sammenligning av ikke-lineære fokuserte bølger. Master Thesis, University of Bergen, 2023

[2] TE Baldock, C Swan, and PH Taylor. A laboratory study of nonlinear surface waves on water. Philosophical Transactions of the Royal Society of London. Series A:Mathematical, Physical and Engineering Sciences, 354(1707):649{676, 1996

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