Accounting for Current in Wave Buoy Measurements

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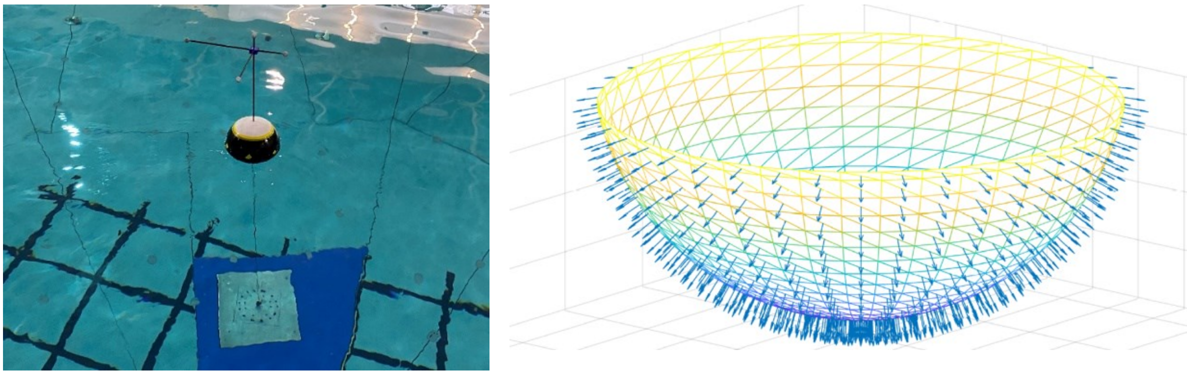
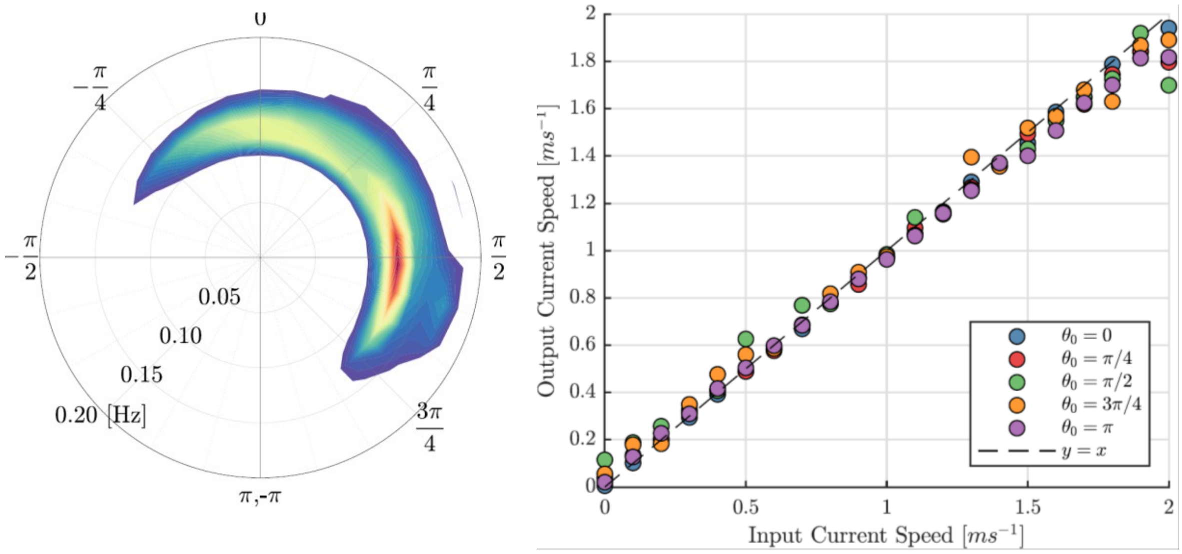
Wave measurement buoys are essential for quantifying the resource for the offshore renewable energy (ORE) sector, but they may be subject to the influence of current which will affect their performance. Even relatively low current velocities may impact the quality of the wave characterisation, and the current itself will exert an influence on a floating structure or device. A more complete understanding of the wave-current interaction can assist multiple ORE technologies, including floating wind, tidal energy, and wave energy through a more complete characterisation of the environmental conditions into which they will be deployed.



Wave buoy behaviour in wave-current sea states was modelled both physically in the FloWave test facility, and numerically using a frequency domain model, with hydrodynamic coefficients obtained through the open source NEMOH Boundary Element Method (BEM) package.

This project used experimental scale modelling at the FloWave test facility at the University of Edinburgh and numerical tools developed by the Universities of Manchester and Exeter to study and describe wave buoy behaviour in realistic wave-current sea states. A particularly exciting outcome was the demonstration of the ability to estimate the current based only on the wave measurement output, which can be subsequently used to correct estimated wave parameters. This opens up the possibility of providing an estimate of current using conventional wave buoy instruments purely through the application of new analysis techniques. Furthermore, many years of historic datasets could be reanalysed to provide improved sea state parameters as well as estimates of current that have previously been unavailable and typically uneconomical to measure.

The investigators have generated and published a framework for the processing of wave buoy measurements under the influence of current, and demonstrated the method using a scale model wave buoy subjected to realistic directionally spread waves with currents at arbitrary angles. The numerical modelling provides an updated wave buoy transfer functions for a generic buoy using opensource modelling tools.



A Mesh Adaptive Direct Search (MADS) algorithm was used to analyse simulated wave-current buoy data, solving for unknown wave and current parameters. It proved capable of resolving complex bimodal spectra, and highly effective at extracting the underlying current velocity at different relative wave-current angles (the input (simulated) vs. output (MADS) speeds shown in plot).

It is anticipated that the method can be effectively applied at full scale in the ocean and provide a powerful and economic tool for improved ORE site characterisation without the need for additional hardware development or investment. The methods developed will allow the errors associated with the effect of current on wave buoys to be quantified. The numerical modelling approach has proven effective at tank scale on a generic spherical buoy, and can be expanded and reconfigured for proprietary geometries and mooring configurations to further improve the estimates of wave spectra and current velocity.

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