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Wave-current interactions at the FloWave Ocean Energy Research Facility

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Physical scale model testing is an important part of the marine renewable energy development process, allowing the study of forces and device behaviour in a controlled environment prior to deployment at sea. FloWave is a new state-of-the-art ocean energy research facility, designed to provide large scale physical modelling services to the tidal and wave sector. It has the unique ability to provide complex multi-directional waves that can be combined with currents from any direction in the 25m diameter circular tank.

The facility is optimised for waves around 2s period and 0.4m height, and is capable of generating currents upwards of 1.6m/s. This offers the ability to model metocean conditions suitable for most renewable energy devices at a typical scale of between 1:10 and 1:40. The test section is 2m deep, which can be classed as intermediate-depth for most waves of interest, thus the full dispersion equation must be solved as the asymptotic simplifications do not apply.

The interaction between waves and currents has been studied in the tank. This has involved producing in the tank sets of regular waves, focussed wave groups, and random sea spectra including multi-directional sea states. These waves have been both inline-with and opposing the current, as well as investigating waves at arbitrary angles to the current. Changes in wave height and wavelength have been measured, and compared with theoretical results.

Using theoretical wave-current interaction models, methods have been explored to "correct" the wave height in the central test area of the tank when combined with a steady current. This allows the wave height with current to be set equal to that without a current. Thus permitting, for example, direct comparison of device motion response between tests with and without current. Alternatively, this would also permit a specific wave height and current combination to be produced in the tank, reproducing recorded conditions at a particular site of interest. The initial tests used a correction factor based on a linear combination of wave and current (Smith 1997), which was found to be reasonably accurate, although the requirement for higher order theory is also explored.

FloWave is a new facility that offers the ability to study wave-current interactions at arbitrary angles with relatively fast currents. This is important as waves and tidal currents at sites of interest for renewable energy generation may not be aligned (Lewis et al. 2014), and so better understanding of these conditions is required.

References

Lewis, M.J. et al., 2014. Realistic wave conditions and their influence on quantifying the tidal stream energy resource. Applied Energy, 136, pp.495–508.

Smith, J.M., 1997. Coastal Engineering Technical Note One-dimensional wave-current interaction (CETN IV-9), Vicksburg, MS.