Probes

It is generally accepted that there are two fundamental mechanisms behind the formation of extreme waves, modulation instability and multi wave interaction [Xiao, et al 2013]. These mechanisms result in two characteristic wave forms, waves that appear in groups and solitary waves, respectively. The Hilbert-Huang Transform (HHT) produces the instantaneous frequency of a signal, showing the dominant frequencies that exist. The interaction of dominant frequencies highlights the responsible mechanism. Multiple dominant frequency components create a solitary wave, and a narrow banded dominant frequency creates a wave that is part of a group, shown below. Therefore, the use of HHT allows for additional information to be derived from the measurements of a single probe, as the mechanism of a waves formation affects both 3D waveform and wave evolution.

2D – Single Probe

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3D – Multiple Probes

Focusing purely on the characterisation of 2D waveforms does not allow for a full understanding of the implications of extreme wave events. Marine energy devices possess a wide range of geometries, meaning surface elevation of a single point is insufficient information to determine the response of a device to a extreme wave. Furthermore, data from a single probe alone does not represent the entirety of a wave, hence the severity of waves may be missed or underestimated.

With the availability of multiple probe measurements it is possible to recreate a wave-field, doing this allows for the observation of the 3D geometry of waves, and their evolution in space and time. Recreation of a wave-field will be using investigated two approaches:

- Numerically
- Experimentally

Characterisation

Having Identified wave mechanisms and observed the resulting geometry and evolution, characterisation can be carried out in 3D

- Steepness/asymmetry vs spectral parameters γ and κ plots
- Proper Orthogonal Decomposition (POD)

References
