Understanding oscillating wave surge converter hydrodynamics through the testing of equation of motion terms

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Work stream 1: Array Planning

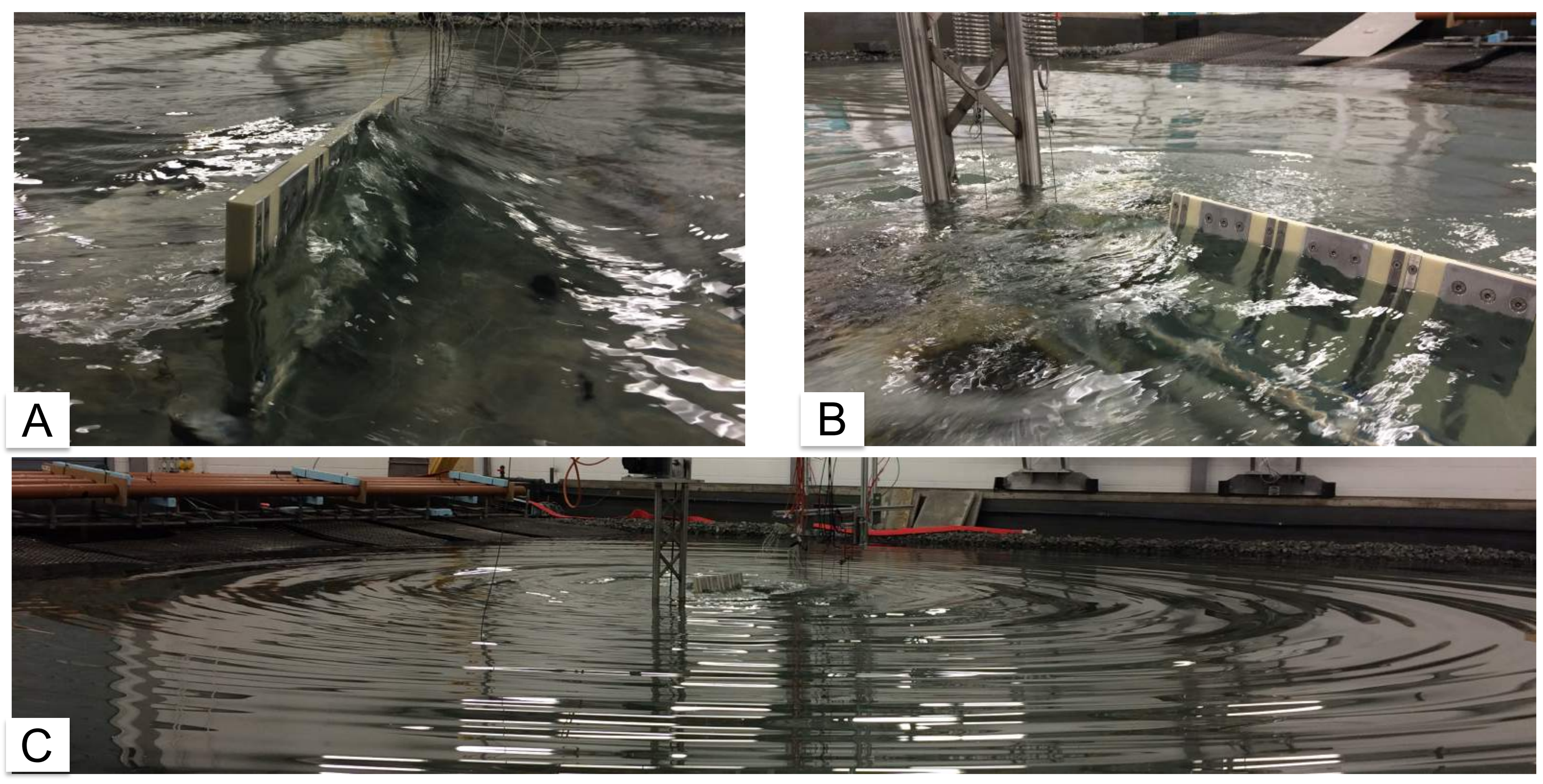
INTRODUCTION

- Time domain numerical models are widely used to obtain wave energy converter (WEC) power and loading estimates. Their coefficients must be well defined to obtain accurate predictions.
- WEC body and linear hydrodynamic coefficients can be obtained either analytically or through use of boundary element method (BEM) codes such as WAMIT or Nemoh. Nonlinear coefficients are harder to define and commonly estimated from physical model tests of entire WEC systems. WEC developers are therefore unclear of the precise source of nonlinearities and how best to model them.
- This study focusses on oscillating wave surge converter (OWSC) hydrodynamics. OWSCs are bottom hinged flap type WECs that couple with the horizontal motion of the water particles in a wave.

Aquamarine Power's Oyster 800® OWSC device operating at EMEC

AIM

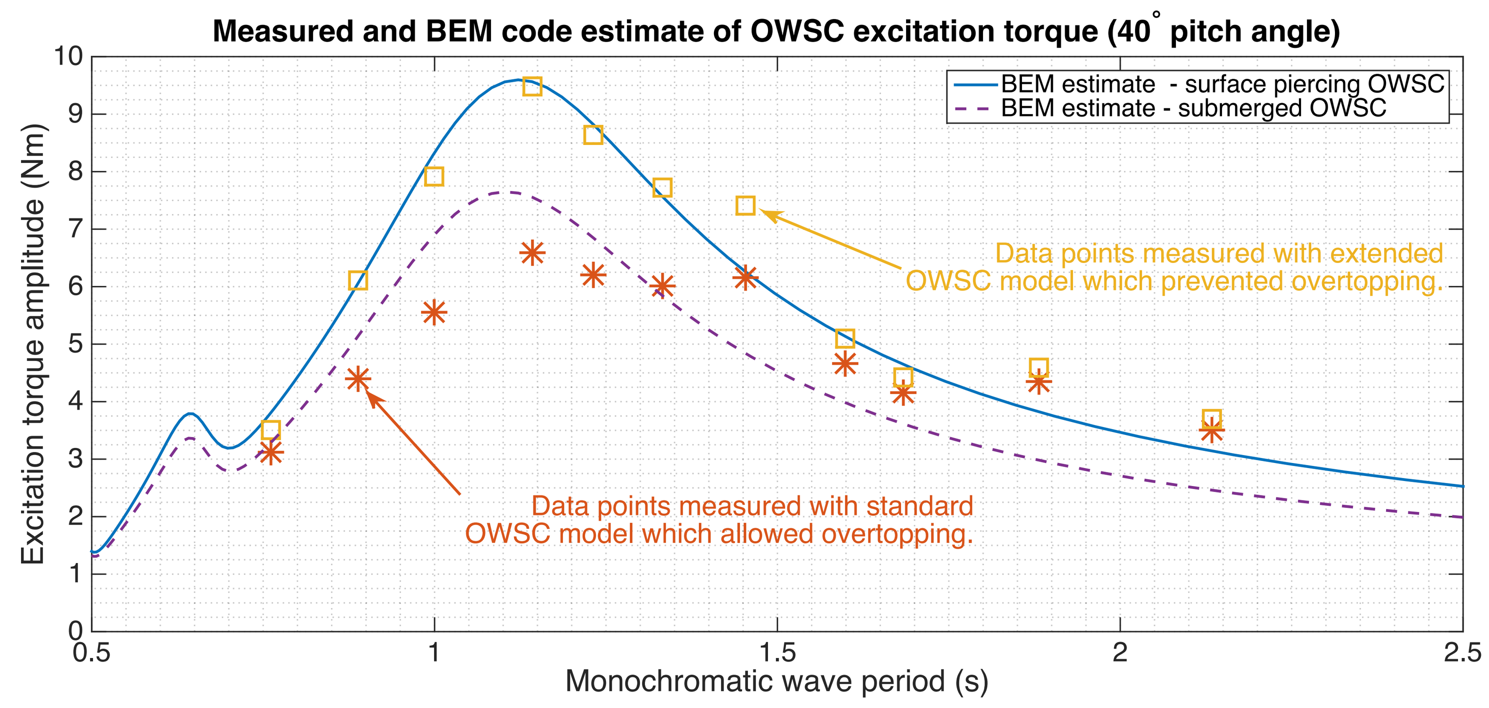
- The aim of this study is to develop the understanding of OWSC hydrodynamics, leading to an improved representation of their influence in time domain numerical models. This aim is achieved by employing both physical and numerical techniques to individually test each of the fluid force terms contained within an OWSC's equation of motion.



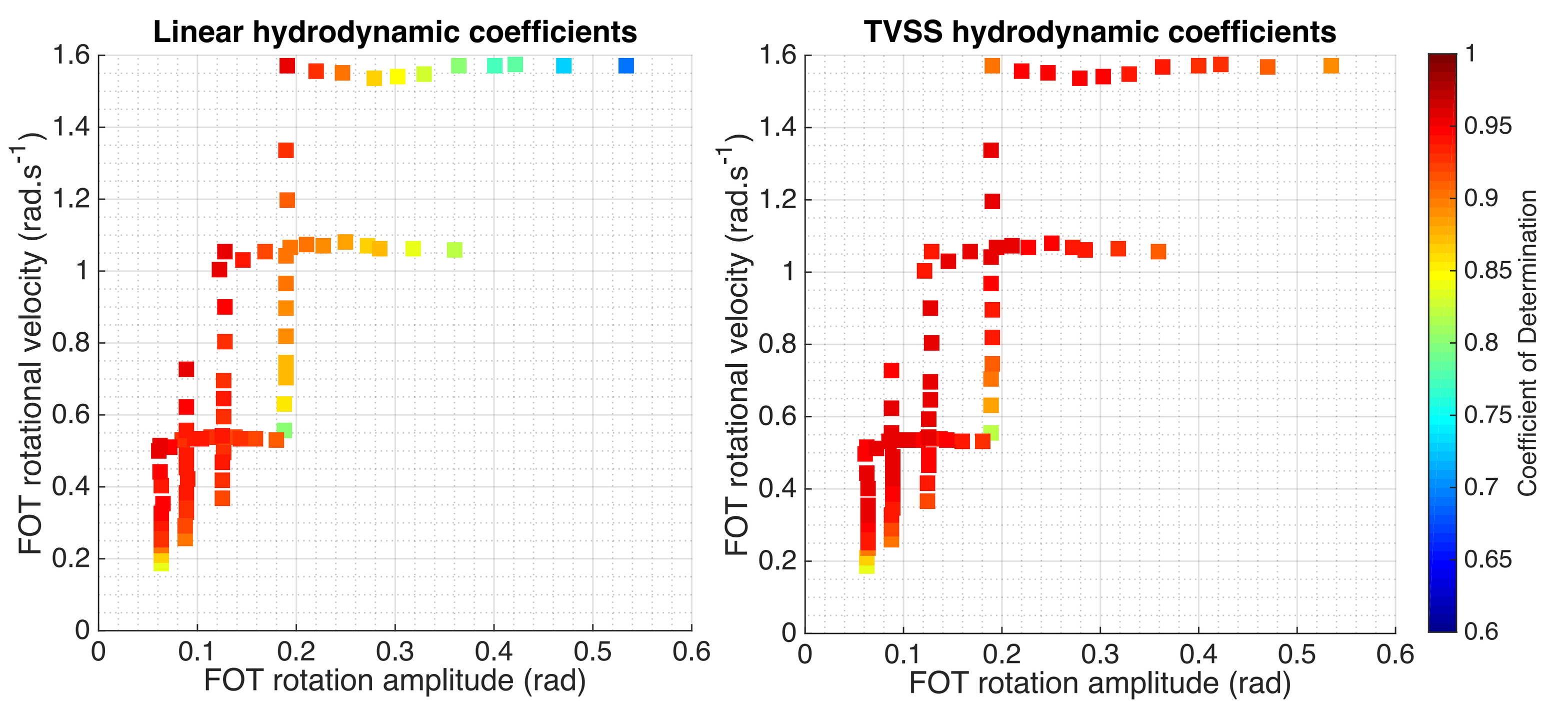
A) Wave excitation, B) Buoyancy simulation & C) Forced oscillation tests.

RESULTS

- Wave excitation tests have shown WAMIT and Nemoh to estimate excitation torque well. Agreement between the BEM codes and measured results is poor though when the OWSC's top edge is near to the free surface where overtopping occurs (e.g. 40° pitch angle).



- Forced oscillation tests (FOTs) have shown WAMIT and Nemoh to predict hydrodynamic torque well when the amplitude of oscillation is small. Agreement between the BEM codes and measured results is poorest for large amplitudes of motion. Agreement between numerical and measured results (measured with coefficient of determination) can be improved by employing a time varying state space (TVSS) method to model hydrodynamics.



- Buoyancy simulation tests (springs used to apply an additional external restoring torque) have shown agreement between linear numerical model and measured results to improve as pitch stiffness increases and OWSC motion is further restrained (Spring set 1 – 4).