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Sandia National Laboratories

Update on WEC-Sim Validation Testing and Code Development

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ABSTRACT

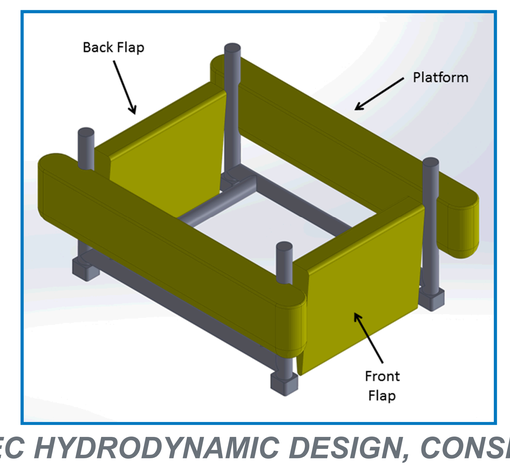
This paper provides an update on the status of the WEC-Sim project, both the code development and experimental testing efforts. Code development has been focused on adding features that improve the fidelity of the simulation, including: non-linear hydrostatic and excitation forces calculation, body-to-body interactions through coupled radiation forces, Morison drag, and more direct modeling of power take-off and mooring components through integration with PTO-Sim and MoorDyn. The experimental testing effort has the main objective of providing a comprehensive dataset with which to validate both the WEC-Sim code as a whole, as well as some of the newest features. The testing was divided into two phases, the first of which was completed in December 2015, and are being conducted at the O.H. Hinsdale Wave Research Laboratory.

CODE DEVELOPMENT

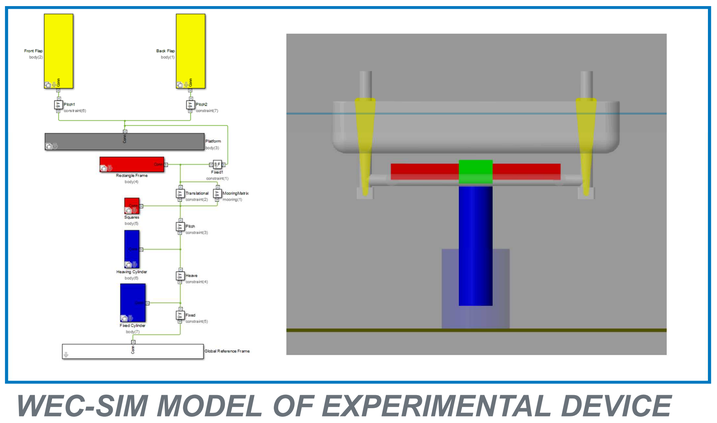
- Body-to-body interactions allows for the motion of one body to have an effect on the other bodies, through coupled radiation forces.
- Morison drag allows for more realistic modeling of the viscous drag as a set of Morison elements.
- Non-linear hydrostatic and excitation forces take into account the instantaneous body position and wave elevation profile.
- PTO-Sim integration allows for more realistic modeling of the power take-off (PTO) components, by directly modeling PTO sub-systems.
- MoorDyn is an open source mooring model that uses a lumped-mass formulation. MoorDyn integration allows for more realistic mooring modeling.
- Visualization in ParaView allows for visualization of the wave field, and of the cell-by-cell non-linear hydrodynamic forces.
- WEC-Sim can now be run in batch mode, allowing users to easily run large numbers of simulations.

NUMERICAL MODELING OF EXPERIMENTAL TESTING

- Initial numerical modeling for decay tests.
- WEC-Sim simulations done with different hydrodynamic flags in order to evaluate the importance of different non-linear forces, as well as to validate these individual new features in the code.
- A full validation of WEC-Sim and its individual features will be done using Phase 1 and Phase 2 experimental data.



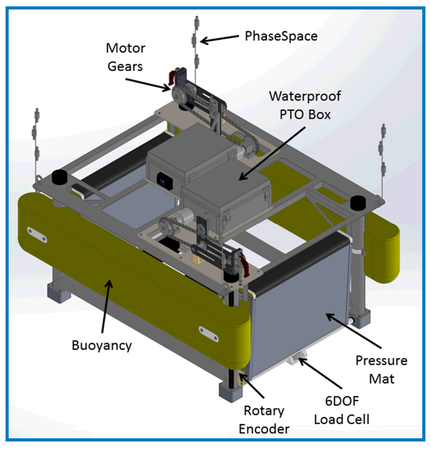
FOSWEC HYDRODYNAMIC DESIGN, CONSISTING OF A FLOATING PLATFORM AND TWO PITCHING FLAPS



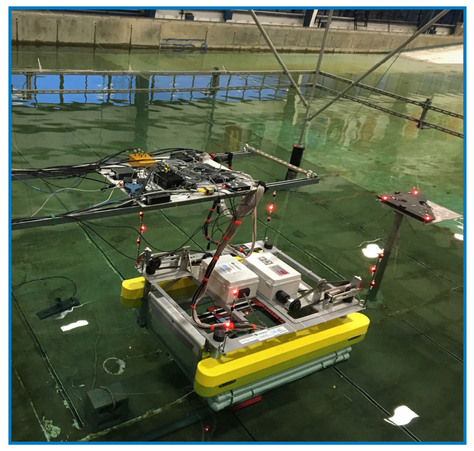
WEC-SIM MODEL OF EXPERIMENTAL DEVICE

EXPERIMENTAL TESTING

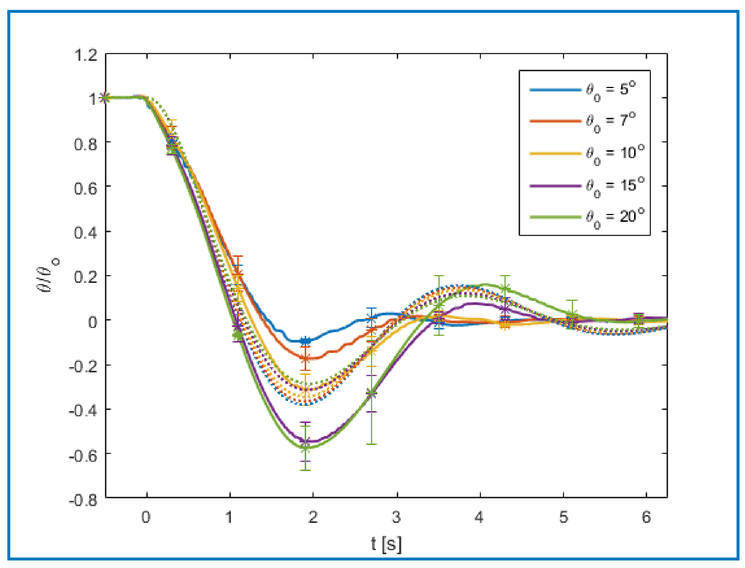
- The floating oscillating surge wave energy converter (FOSWEC) device consists of a floating platform and two pitching flaps.
- Experiments are ongoing at the O.H. Hinsdale Wave Research Laboratory
- Phase 1 was completed in December 2015 and was focused on characterizing the device and performing a range of tests to verify the WEC and instrumentation are functioning properly. Phase 2 is scheduled for spring 2016 and will focus on running a range incident wave cases to characterize the performance of the FOSWEC.
- A constraint arm holds the WEC in place and constraint the motion of the platform to any combination of heave, pitch, and surge motion. This together with the ability to lock the flaps allow for the ability to iterative increase the complexity of the FOSWEC's response.
- The primary instrumentation provides the necessary data for WEC-Sim validation, such as motion tracking in every degree of freedom. The secondary measurements will be useful for the extreme conditions project and to guide future experiments in the wave energy community at large.



OVERVIEW OF FOSWEC INSTRUMENTATION



EXPERIMENTAL TESTING OF THE 1:33 SCALE FOSWEC



EXPERIMENTAL (SOLID) AND NUMERICAL (DASHED) FLAP DECAY RESULTS FOR DIFFERENT INITIAL DISPLACEMENTS

ACKNOWLEDGMENTS

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