Design and Modification of Wave Energy Converters for Autonomous Docking and Recharging

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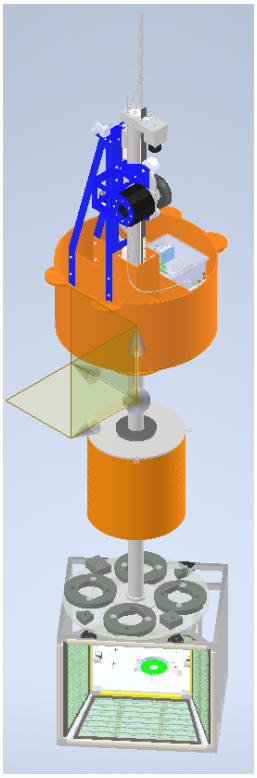
1.1 Background/Objectives

Full wave-to-wire prototype development, testing, and validation of autonomous underwater vehicles (AUVs) docking with and recharging from wave energy converters (WECs) is a missing knowledge gap and a fundamental precursor to the deployment of long-duration underwater systems. AUV-WEC docking and recharging technology has the potential to enable long-duration monitoring, intervention, and maintenance over continuous durations of months to years. To move towards fieldable WEC/AUV docking systems, we are designing modifications for the 1:20 scale Lab Upgrade Point Absorber (LUPA) and the 1:33 scale Floating Oscillating Surge Wave Energy Converter (FOSWEC) to accommodate existing AUV docking infrastructure. Both WECs offer unique test conditions for the docking system and robot dynamics.

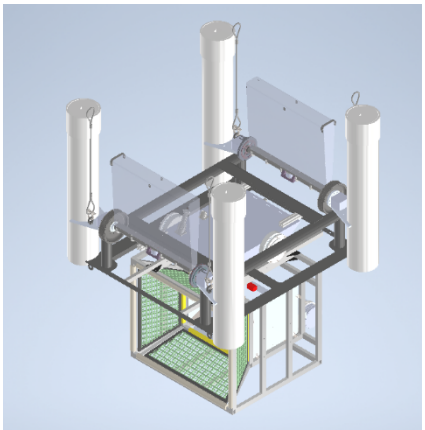


LUPA-DOCK

Objectives include mechanical modifications of the dock and WECs, simulating the DOCK/WEC system in wecSim, and testing the system in the O.H. Hinsdale Wave Research Laboratory at Oregon State University. These objectives aim to provide proof of concept for wave-to-wire capability with both the LUPA and FOSWEC.

1.2 Approach/Activities

To modify our existing AUV dock for WEC compatibility, we plan to implement two cross-braces onto the dock. This is a simple modification that ensures compatibility between systems. LUPA and FOSWEC require a few changes for testing, including cross-braces, an added buoyant force for FOSWEC, and weight and height modifications for LUPA. Power systems play a significant role in this system. We are developing a testing system that can receive, measure, and transfer the power from the WEC to the dock. This power may be stored or sent directly to the AUV's charger that requires 150W for AUV charging. The goal is to achieve net positive charging for the AUV in wave lab conditions.



FOSWEC-DOCK

1.3 Results/Lessons

To understand the system dynamics of the DOCK/WEC systems, we will perform wecSim simulations to provide understanding of the float heave response, mooring configuration, and wave response. Testing in November of 2026 will provide us with an opportunity to compare the simulations and real-world conditions using variable scaled wave conditions to simulate the waves at the PacWave test site in Oregon. We plan to test the mechanical connections between the WECs, the power electronics, and the autonomous docking/charging. Potential risks include mechanical failure, corrosion, unanticipated forces, and poor electricity generation.