POWER OPTIMIZING CONTROL OF A WAVE ENERGY CONVERTER WITH A HYDRAULIC POWER TAKE OFF

BRADLEY A. LING, TERRY LETTENMAIER

[1]*Corresponding author, Northwest Energy Innovations, Portland, OR, lingb@azurawave.com*
[2]*Williwaw Engineering, Newport, OR, lett@peak.org*

Advanced control strategies such as model predictive control has been shown in simulations to dramatically increase the power capture of wave energy converters [1]. Some published research on WEC control accounts for force or torque limits un the control strategy. But there is a significant gap in developing control strategies for power take-offs (PTOs) that are unable to arbitrarily specify torque in a given range. For example, direct drive and geared electrical generators can obtain low level torque control with sophisticated power electronics systems that regulate the electrical current in the generator. Hydraulic PTOs are controlled with directional valves, motor displacement settings, and motor torque control. This makes achieving a commanded arbitrary torque at any moment of time much more challenging.

To overcome the challenge presented by the dynamics of the hydraulic PTO, a model predictive controller is modified to control the hydraulic PTO. The project is evaluating different hydraulic PTO topologies and control strategies to determine a suitable system for power maximizing control with a hydraulic PTO. The different PTO topologies and control strategies are evaluated in software, using WEC-Sim [2] to model the hydrodynamics of the WEC.

After the controller is evaluated in simulations, the effectiveness of the control strategy will be evaluated with wave tank testing. Since it is impractical to design an accurate scaled model of the Hydraulic PTO, hardware in the loop simulations will be used to simulate the hydraulic PTO. A block diagram of the test setup is shown in Figure 1. The system connects a physical tank model to a software model of the hydraulic PTO that simulates the PTO dynamics in real-time. This allows the dynamics of the hydraulic PTO to be incorporated into the scaled testing.

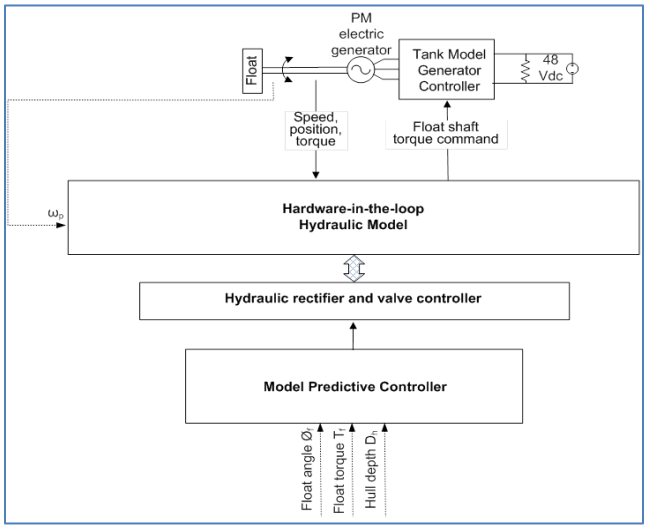

FIGURE 1. WAVE TANK VALIDATION BLOCK DIAGRAM.

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