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A maximum capture width tracking controller for a wave energy converter in stochastic waves

Abstract Optimal control of ocean wave energy converters (WECs) has been a popular field of research since the 1970’s, however, a controller which is both efficient and practical is yet to be found. WEC controllers which maximise power on a wave-by-wave basis require accurate prediction of the incoming wave time-series which is currently not feasible. Motivated by the difficulty of wave prediction, non-model based adaptive controllers have been developed which optimise WEC power take-off (PTO) parameters for the present sea state. Maximum power point tracking (MPPT), a gradient-ascent type method commonly used in wind and solar energy converters, has been applied to WEC control in stationary sea states with some success, however, real ocean waves are not stationary and MPPT algorithms are known to become confused in changing environmental conditions.

This presentation will introduce a maximum capture width tracking (MCWT) controller, being an MPPT controller modified to account for incoming wave conditions as well as WEC power output. The MCWT controller will be applied to latching control of an oscillating water column with Wells turbine, optimising the latching time based on sea state. The performance of the MCWT latching controller will be compared to that of an MPPT latching controller in both stationary and transitioning sea states, where MCWT robustness in changing environmental conditions will be demonstrated. Finally, it will be shown that the proposed controller can yield optimal capture width within the bounds of uncertainty that optimal capture width can be known for a WEC in stochastic waves.

This is a joint work with Benjamin Cazzolato, Boyin Ding and Zebb Prime.