Novel Model of an Adaptive Wave Energy Converter With Spectral Analysis-Based Sea State Classification

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The objective of this project is to measure the effects of adaptive control on the performance of a wave energy converter (WEC). Ocean wave energy is one of the most promising sources of renewable energy with a measured annual 2.64 trillion kWh. This energy is harvested via WECs, which utilize a power-take-off (PTO) system to convert the kinetic energy of wave movement into usable electrical energy. The most common type of WEC is the point absorber, and one limitation of WECs is the unstable electrical power generation across changing climates. To solve this problem, an adaptive model of a point absorber with a hydraulic PTO was designed. The adaptive model consisted of a spectral analysis-based sea state classification algorithm and an alterable swashplate angle ratio. The adaptive model is compared to a non-adaptive model on a phased simulation to determine the megawattage. The results showed that the adaptive WEC generated 19.928% more electrical power than the control WEC, and the results were found to be significant via a t-test. It was found that an adaptive WEC could significantly increase the electrical power generation and maximize performance across sea state changes.

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