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Novel Control Strategy of Wave Energy Converter using Linear Permanent Magnet Synchronous Generator

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There are two ways to maximize the electric power extracted from a Wave Energy Converter(WEC): The first is a passive method through the design of the buoy shape and the next is an active method by controlling the phenomenon that occurs when a Power Take Off(PTO) device extracts maximum electric power. The former method does not have a considerable degree of freedom and has several practical constraints because it depends on the structure and property of the buoy. Therefore, the latter can improve the quantity of the extracted power more conveniently through a control strategy. The permanent magnet linear generator is directly connected to a buoy and the applied WEC system extracts power through damping control. This study proposes a high-speed operation damping control strategy for a WEC. Further, a damping control method that could improve the extracted power for a wide speed range is examined. The mechanical dynamic characteristics of a WEC system against the heave motion is analyzed. The added mass, radiation damping coefficient, and the excitation force are determined using ANSYS AWQA numerical analyses. The viscous damping coefficient is derived from the free-decay test of a 1/25 down-scaled model. The results of this study show that it is possible to expand the operating region and maximize the power extraction by software implementation only, without additional hardware. The validity and benefits of the proposed control algorithm are verified by experimental results using a down-scaled WEC model. The dynamo motor speed by wave dynamics analysis is calculated and then speed command is transferred to the dynamo motor drive. The wave dynamics are second-order differential equation. In this paper, for solving the equation, the Runge-Kutta 4th method is applied. The numerical results of the model well agreed with the experimental data.

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