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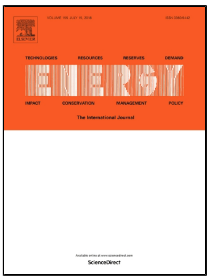

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Energy extraction of wave energy converters embedded in a super-scale modularized floating platform

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Abstract

An embedded wave energy converter installed in a super-scale modularized floating platform is proposed for wave-induced kinetic energy extraction. The platform consists of multiple blocks where on-top huge modular decks are flexibly supported by floating semi-submergible modules via elastic cushions. For the connection between adjacent blocks, neighboring decks are joined by rigid hinges and neighboring floating modules are connected by two piston-type devices that are embedded wave energy converters (WEC), designed by the linear hydraulic power take-off (PTO) mechanism. Based on linear wave theory and rigid module flexible connector (RMFC), the dynamic model for the modularized floating platform is developed by using a network modeling method. In numerical case studies, the wave energy extraction of a five-block platform is investigated and the design region for the key parameters of the WEC is recommended. In addition the effects of the WECs on dynamic responses and the connector loads of the modularized platform are studied. These results can improve the understanding on the performance of the specific platform.

Key words: Wave energy farm, very large floating structure, WEC, PTO

1. Introduction

The wave energy is one of the four main sources of marine renewable energy which is estimated around 2TW worldwide[1]. Using waves as a source of renewable energy offers significant advantages, such as a low level of negative environmental impact[2], the highest energy density among all the renewable energy sources[3], power flux well probabilistically forecasted 48h in advance[4], better continuity of power supply in a day[5] in comparison with other forms of renewable energy.

Since wave energy started to receive worldwide attention in the 1970s[6], more than one thousand different prototypes developed during the last decades. However, none of the existing wave energy devices has been commercially completed yet due to high anticipated cost and low efficiency compared to the cost of electricity generated by large-scale traditional power plants[7]. So, the techniques of wave energy harvesting are still at an early stage of development[8]. Moving from standalone device toward hybrid systems embedded with coastal or offshore structures is a promising way. It can achieve the results of the capital cost reduction and efficiency enhancement in engineering applications. Michailides and Angelides [9] proposed an embedded wave energy harvesting floating system, which functions not only the shore protection but also wave energy production by using linear hydraulic PTOs. The implementation of the PTO devices within the flexible floating breakwater could significantly enhance the capture width of each device. Astariz and Iglesiaso [10,11] analyzed and quantified the power variability of the combined wave and wind energy farm with various configurations. Their results showed that co-located farm is an opportunity to rise the power generation from renewable in a cost-competitive way. Apart from