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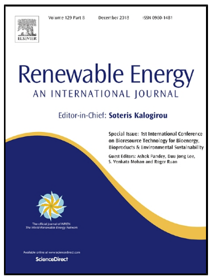

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Investigation on long-term extreme response of an integrated offshore renewable energy device with a modified environmental contour method

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Abstract

Considering the massive simulations required by the full long-term analysis, the environmental contour method is commonly used to predict the long-term extreme responses of an offshore renewable system during life time. Nevertheless, the standard environmental contour method is not applicable to the wind energy device due to the non-monotonic aerodynamic behaviour of the wind turbine. This study presents the development of a modified environmental counter method and its application to the extreme responses of a hybrid offshore renewable system. The modified method considers the variability of the responses by checking multiple contour surfaces so that the non-monotonic aerodynamic behaviour of the wind turbine is considered. The hybrid system integrates a floating wind turbine, a wave energy converter and two tidal turbines. Simulation results prove that the modified method has a better accuracy.

Keywords: extreme response, environmental contour method, renewable energy, floating wind turbine, wave energy converter, tidal turbine

1. Introduction

Powered by the increasing global pursuit of offshore renewable energy, various types of ocean energy systems are developed, including the floating wind turbine, the wave energy converter and the tidal turbine. Studies on an individual energy system have been fully conduced [1-5]. Nevertheless, producing power from a single type of ocean energy resource faces the problem of high cost and low harvesting efficiency. Therefore, the concept of integrated offshore renewable energy devices is proposed.

Nehrir et al. [6] presented a review of hybrid renewable energy systems, in term of configurations, control and applications. Aubault et al. [7] incorporated an oscillating-water-column WEC into a semi-submersible floating wind turbine. They showed that the overall cost could be reduced by sharing the mooring system and the power infrastructure. Muliawan et al. [8] studied the dynamic response and the power performance of the so-called STC concept in various operational conditions. Their simulation results revealed a synergy between wind and wave energy generation. Experimental and numerical

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