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Synthetic Optimizing Control of Wind-Wave Hybrid Energy Conversion System

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Abstract : A hybrid energy conversion system composed of a floating offshore wind turbine (FOWT) and wave energy converters (WECs) may possibly reduce the levelized cost of energy, improving the platform dynamics and increasing the capacity to harvest energy. This paper investigates the aerodynamic performance and dynamic responses of the combined semi-submersible FOWT and point-absorber WECs in frequency and time domains using synthetic optimizing control under turbulent wind and irregular wave conditions. Individual pitch control is applied to the FOWT part, while spring–damping control is used on the WECs part, as well as the synergistic control effect of both are studied. The effect of the above control optimization is analyzed under several typical working conditions, such as below-rated wind speed, rated wind speed, and above-rated wind speed by OpenFAST and WEC-Sim software. Particularly, the wind-wave misalignment is also comparatively investigated, which has demonstrated the importance of applying proper integrated optimal control in this hybrid energy system. More specifically, the combination of individual pitch control and spring–damping control is able to mitigate the platform pitch motion and improve output power. However, the increase in blade root load needs to be considered which needs further investigations in the future.

Keywords : floating offshore wind turbine, wave energy converters, control optimization, individual pitch control, dynamic response
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