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Hydrodynamic study on horizontal-axis tidal current turbine with coupling motions

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ABSTRACT

Hydrodynamic characteristics of floating horizontal-axis turbine are affected by the wave-induced motion response of the floating platform for the turbine system. In order to analyze this problem, the computational fluid dynamic (CFD) technique has been adopted to simulate the hydrodynamic characteristics of the turbine with rotation and yawing coupling motions in constant inflow, and study how the hydrodynamic performance of the turbine is affected by yawing frequency, yawing amplitude, and tip speed ratio. Based on the time-varying hydrodynamic curves of the turbine from the simulation data of CFD, yawing damping coefficient can be obtained by the least-square fitting. The results demonstrate that: compared with turbine only rotating in constant inflow, the instantaneous value of the axial loads coefficient, power coefficient, and yawing moment coefficient generate fluctuation, the fluctuation amplitudes of these three parameters have a positive correlation with the frequency and amplitude of the yawing motion and tip speed ratio; the frequency and amplitude of the yawing motion have little impact on yawing damping coefficient but this coefficient is positively proportioned to the rotational speed of the turbine. The results of this research can provide data to study the motion response of floating platform for floating tidal current turbine system and electric control design.

Keywords: Tidal current energy; Horizontal-axis turbine; Yawing; Hydrodynamic force; Damping coefficient

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