DESIGN AND SIMULATION OF A NOVEL SUBMERGED PRESSURE DIFFERENTIAL WAVE ENERGY CONVERTER FOR OPTIMIZED ENERGY HARVESTING EFFICIENCY AND PERFORMANCE

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A novel submerged pressure differential wave energy converter (SPDWEC) has been designed and simulated for energy harvesting under both regular waves and irregular ocean waves. As the waves pass by, the oscillating water pressure on the flexible surface of the SPDWEC moves the pistons of the power take-off (PTO) system, in such a way the wave energy is converted into electricity. Hydrodynamic responses of the SPDWEC are simulated by a numerical model calculating both the linear wave forces and the nonlinear effect of wave height reduction caused by energy extraction. The results show that the SPDWEC can reach a high power capture ratio through system optimization of the stiffness and damping of the PTO system. This innovative SPDWEC exhibits improved lifetime and maintainability by enclosing the PTO inside the WaveHouse, where the overall air pressure keeps nearly constant. As shown in Figure 1, the optimal power capture ratio of the SPDWEC ranges from 0.21 to 0.32, which means the PTO system can extract 20-30% of the incident wave energy. The ideal power capture ratio, which does not consider the nonlinear effect caused by energy extraction, is much larger than the optimal power capture ratio and is larger than one for wave periods larger than 9 s.

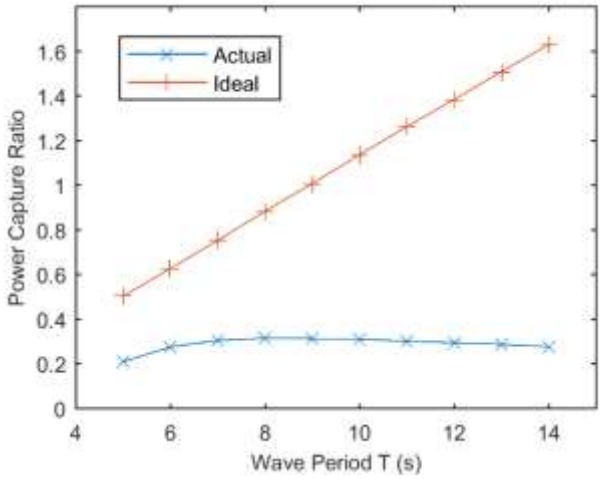

Figure 1. Power capture ratio with respect to wave period