Offshore & Dredging Engineering

Technische Universiteit Delft

Power efficiency of the gyroscopic-pendulum Wave Energy Converter

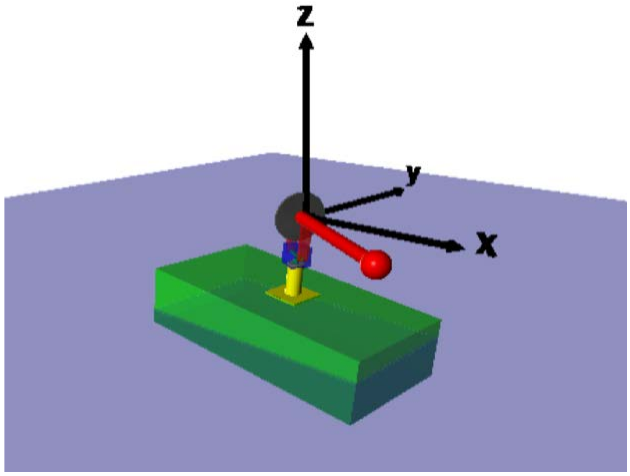
The oceans, which cover nearly 70% of the earth's surface, can be considered as an inexhaustible energy source for renewable electricity due to its size and predictability. One way to capture ocean energy is by harnessing the energy produced by waves at sea, by means of devices called wave energy converters (WECs).

Delft University of Technology is developing a new floating WEC concept called the "gyroscopic-pendulum (gp)". This concept is a modification of the so called "classical vertical axis pendulum (cp)", which is capable of producing mechanical power harvested from the rotations of the pendulum around the vertical axis.

The new concept is proposed by adding a flywheel with the aim to enhance the rotations of the pendulum about the vertical axis. The enhancement comes from gyroscopic precession which is created due to a change in the angular moment of the spinning flywheel caused by the torque originating from the weight of the pendulum.

This thesis starts with a general introduction about wave power followed by the mathematical and numerical model of the gyroscopic-pendulum. Numerical simulations are performed in which the gp and the cp are both imposed with the same harmonic roll motion, while the gp system also receives some power input to rotate the disk. The main objective is to find out in which ranges of amplitude and frequency of imposed motions, the gyroscopic-pendulum results in an improvement of the power efficiency compared to the classical vertical axis pendulum.

The results obtained from tests performed in the simulated conditions, shows us that the gyroscopic-pendulum has a significantly higher efficiency compared to the classical vertical axis pendulum when the frequency of the imposed roll motion is in the range of 1.4 to 1.75 rad/s and the amplitude is the range of 0.6 to 0.95 m.



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