# Development of Numerical Model of Heaving-Buoy-type Wave Energy Converters Using Numerical Wave Tank Technique

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**Abstract**

The numerical model of the heaving-buoy-type point absorber (HPA) wave energy converters (WEC) with a hydraulic Power Take-off (PTO) system has been developed. The HPA extracts wave energy from the vertical motion of buoy, and the diameter of buoy is relatively small compared to the wavelength. Using the three-dimensional potential numerical wave tank technique (3D-PNWT), hydrodynamic performance of the HPA with a hydraulic PTO system was examined. The NWT technique is very effective to simulate nonlinear waves and describe the nonlinear wave-body interactions. The MEL (mixed Eulerian-Lagrangian) method was used to simulate nonlinear water particle motions under nonlinear free surface boundary conditions. The acceleration potential method was adopted to calculate the wave force on the floating buoy accurately. An artificial damping zone scheme was used to avoid wave reflection from the end wall of computational domain and satisfy the open sea condition. Details of numerical schemes used in the 3D-PNWT were reported by Kim (2018). A hydraulic PTO system was numerically modelled as the approximate coulomb damping force (Kim et al. 2019a). Using the developed PNWT model, interactions of nonlinear waves, buoys, and PTO system were fully analysed.

Wave generation and propagation problem, wave diffraction problem, radiation problem, and wave-body interactions were examined systematically to verify the 3D-PNWT technique (Kim, 2018). The numerical results were compared with the previous numerical studies and theoretical solutions. Various numerical analyses have been conducted, such as linear simulation, partially nonlinear, and fully nonlinear simulations, to find the nonlinear effect of wave-HPA-PTO interactions(Kim et al. 2018). In addition, the latching control strategy was applied to the numerical model of WEC to find the optimal control condition for maximum wave power generation (Kim et al., 2019b).

***Keywords:*** *Wave energy converter, Point absorber, Three-dimensional numerical wave tank, Acceleration potential, Hydraulic power take-off system, Latching control*

## References

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