Wave Power Extracting System with Multi-Resonators Attached to Vertical Breakwaters

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ABSTRACT

Ocean wave is one of renewable energy sources, of which the theoretical energy potential is estimated to be 32,000TWh/yr according to Mørk et al. (2010), however, that is highly underutilized up to recently. In this study, a new system is proposed, that can enhance not only the efficiency of the system by using resonant phenomena in wave channel but also the economic feasibility by using existing caisson-type breakwater as support structure. To evaluate the performance of proposed system, numerical analyses by using Galerkin’s finite element model based on the linear potential theory were carried out for various damping ratio which is directly related to extracting wave power. Numerical results reveal that the performance of the proposed system is fairly good compared with that of the conventional one.

KEY WORDS: Wave energy; linear generator; regular wave; resonance; numerical simulation; finite element method.

INTRODUCTION

Worldwide interest in development of renewable energy is being heightened due to the depletion of fossil fuel and how to reduce the greenhouse gas. Ocean holds various renewable energy sources, i.e., wave, tide, tidal current, salinity, ocean temperature difference, offshore wind, and so on. So, many countries have interested in utilization of ocean energy.

Among ocean energy sources, ocean wave is treated as an important one, because the theoretical energy potential is estimated to be 32,000TWh/yr (Mørk et al., 2010). The technical potential of wave energy will be substantially below the theoretical amount and will depend upon technical developments in wave energy devices. The primary limiting factor is the efficiency of PTO (power take off) system, and secondary factors are the survivability in harsh storm conditions and high installation/maintenance cost. A lots of concept have been proposed for harvesting wave energy (e.g. Evans, 1976; Kim and Choi, 1983; Gato and Falcão, 1988; McCormick, 2007; Grilli et al., 2007; Elwood et al., 2007; Koo and Kim, 2010; Cho et al., 2012; Koo et al., 2012; Park et al., 2013).

In this paper, a wave energy converter (WEC) is presented, that can enhance not only the efficiency of PTO but also the economic feasibility.