A small-size ocean wave energy harvester based on inertial mass

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In order to continuously supply electrical power to small-size ocean observation equipment such as sonobuoys, a device harvesting energy of ocean waves is proposed. It consists of two main parts: a magnet fixed to the floating case which follows the motion of the ocean surface; a moving coil and an inertial mass joined together and connected to the case via a flexible spring. Because of inertial mass and spring, a lag appears between coil/mass and case motions. Based on Faraday's law of electromagnetic induction, a voltage is induced in the coil due to relative velocity between the coil and the magnet and kinetic energy of the ocean wave is converted into electrical energy. Compared to the traditional linear permanent magnetic generator used in offshore power plant, this device has the advantage of to be free of movement and to have a small size with respect to ocean wavelength. This energy harvesting device is first analysed based on vibration equations of a single degree of freedom system. The performance is then simulated using FEM software and circuit analysis. Finally, vibration experiments are conducted on a prototype mounted on a shaker and immersed in a water tank in order to characterize energy harvesting performance.