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1 Introduction

The Ocean Grazer (OG) is a massive platform designed and developed by the University of Groningen, which is capable of extracting and storing multiple forms of energy including wave, wind and solar. The bulk of the energy input is projected to be harvested by a novel wave energy converter (WEC). Unlike existing devices, the OG-WEC aims to adapt to the different sea states, so the maximum amount of energy can be extracted. Accordingly, the main objective of the OG platform is to convert ocean wave energy into electrical energy, which in turn can help to improve the global environmental conditions.

In this work, we investigate the influence of the OG-WEC in the energy extraction process and the motion of particles in an incoming wave. Moreover, it is of particular interest to determine how much energy is used by an OG-WEC prototype, and how much remains unused. Consequently, the digital particle image velocimetry (DPIV) technique is used to study the kinetic energy of particles within a wave tank.

2 Experimental setup

In the experimental setup of the OG-WEC prototype, wave motion is simulated by a motor located next to the prototype structure in a small wave tank. The motor can be adjusted to simulate monochromatic waves of several heights and frequencies. The OG-WEC prototype consists of ten coupled floating buoys or floaters, termed the floater blanket, each one attached to an adaptable piston-type hydraulic pump [1]. The velocity of the piston is determined by the velocity of the floater, which is in turn influenced by the vertical velocity of the wave motion [1].

The DPIV technique is commonly used for non-intrusive, quantitative and qualitative flow visualization [2]. The technique requires the following: a camera, a laser sheet, reflective particles (polyamide particles), and a software package for data post-processing (PIVlab tool). The fluid which is illuminated corresponds to a small area with a very thin cross-section. The camera is positioned parallel to fluid capturing the whole illuminated area containing the highly-reflective suspended particles; see Figure 1.

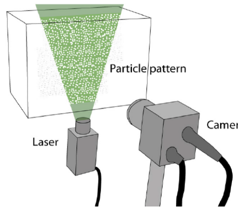

Figure 1: Principle of the DPIV technique [2].

A collection of images corresponding to the position of the suspended particles in the wave tank are then obtained. Subsequently, the particles' velocity can be estimated, which in turn can be used to calculate the kinetic energy using the well-known formula $E_k = \frac{1}{2}mv^2$. In Figure 2, the variations in kinetic energy are shown for a small area under the floater blanket for a wave with a height of 8cm and a period of 1.6s. In this figure, the energy components in the vertical and horizontal directions can be observed.

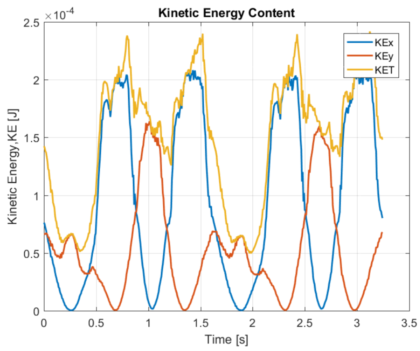

Figure 2: Kinetic energy while the OG-WEC is operating.

References

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