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Experimental study on waves propagation over a coarse-grained sloping beach

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This study investigates velocity fields of wave propagation over a coarse-grained sloping beach using laboratory experiments. The experiment was conducted in a wave flume of 25 m long, 0.5 m wide and 0.6 m high in which a coarse-grained sloping 1:5 beach was placed with two layers ball. The glass ball is D=7.9 cm and the center to center distance of each ball is 8.0 cm. The test section for observing wave and flow fields is located at the middle part of the flume. A piston type wave maker driven by an electromechanical hydraulic serve system is installed at the end of the flume. The intrinsic permeability Kp and turbulent drag coefficient Cf were obtained from steady flow water-head experiments.
The flow velocity was measured by the particle image velocimeter (PIV) and digital image process (DIP) techniques. Eleven fields of view (FOVS) were integrated into a complete representation including the outer, surf and swash zone. Details of the definition sketch of the coarse-grained sloping beach model as well as experimental setup are referred to Lai et al. (2008). A high resolution of CCD camera was used to capture the images which was calibrated by the direct linear transform (DCT) algorithm proposed by Abed El-Aziz and Kar-Ara (1971). The water surface between the interface of air and water at each time step are calculated by Otsu' (1978) detect algorithm. The comparison shows that the water surface elevation observed by integrated image agrees well with that of Otsu' detection results.
For the flow field measurement, each image pair was cross correlated with 32X32 pixel inter rogation window and a half overlap between adjacent windows. The repeatability and synchronization are the key elements for both wave motion and PIV technique. The wave profiles and flow field were compared during several wave periods to ensure that they can be reproduced by the present system. The water depth is kept as a constant of h=32 cm. The incident wave conditions are set to be wave height H0 = 3.86 cm or 7.75 cm and wave period T = 1.0 s. The illumination source of the PIV system is a dual-head frequency-doubled Nd:YAG laser, which has a maximum energy output of 120 mJ per pulse at two wavelengths of 523nm and 266nm. A synchronizer controls the emission time of a pulse laser beam as well as the camera exposure and shutter time.
Linear wave theory (LWT) of wave propagation over a constant water depth was tested to validate the DIP/PIV algorithm. The comparison of velocity profiles in X and Z directions are in good agreement with those of LWT.
Waves propagating over a coarse-grained sloping beach were investigated using PIV/DIP techniques. Detailed analysis of experimental results show that the flow field, turbulent intensity and vorticity are primarily located above the wave trough. A detailed description is provided in terms of free surface, velocity field, and turbulent energy transport.

References

1. Abdel-Aziz, Karara.1971, Direct linear transformation into object space coordinates in closerange photogrametry. In Proc. Symp. Close-Range Photogrametry, 1-18.
2. Flow-3D (2008) user manual, version 9.3.
3. Otsu N. 1978. A threshold selection method from gray level histogram, IEEE Trans. on System, Man, and Cybernetics, 8, 62-66.