Experimental Study on Vegetated Channel Flow Field Using Color Partical Image Velocimetry Method

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Abstract

There are three types of the reactions of the vegetation: erect, waving and prone when flow passes vegetated channel. This study focuses on the erect type to investigate the influence of different vegetated density on the variation of velocity. The cylinder of resin is used as the model plant, with diameter of 0.65 cm and height of 3 cm. There are seven sets of vegetated density. The characteristic volume ratio (m') is used to represent the vegetated density, and it is defined as ratio of the plants' volume to unit fluid volume. The flow discharge in the experiment is controlled in the range of 70(l/min)～90(l/min) and the flow depth is 5 cm in the upstream boundary.

Because the flow is affected by the vegetation, the flow field changes rapidly. If the traditional single-point measurement at a time is adopted in the experiment, the variation of the velocity field in the vegetated channel cannot be obtained completely and effectively. Hence, this study adopts non-intrusive color particle image velocimety (CPIV) to measure the vertical 2-D flow field in the vegetated channel. The CPIV method uses Argun laser as the light source, the PCAOM separates the light into blue and green lights and they form a light sheet after emitting on a rotating eight-side mirror, the CCD takes the instantaneous images of vegetated channel flow field, and then obtains the velocity field through the set-up of interrogation window and image analysis. Finally, the associated vorticity can be calculated by the central difference scheme based on the measured velocity components at each point.

After measuring the vegetated channel flow field with the CPIV method, the stronger vorticities occur in the interface between air and fluid, near the bed of the vegetated channel and the vicinity of the model plant. In addition, the relationships among the increasing rates of the mean and maximum velocities and the distance from the water surface of the maximum velocity at the top of the third-row model plant with respect to the characteristic volume ratio are also analyzed. It can be found that the exponential relationships exist with high correlation coefficients.