

Experimental Study on Open Channel Flow Over a Backward Facing Step Using Color Partical Image Velocimetry Method

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Abstract

The purpose of this study is using non-intrusive color particle image velocimetry method (CPIV) to measure the 2-D vertical flow field in open channel flow over backward facing step. The CPIV method uses Argon laser as the light source, the CCD controlled by the PCAOM to take the instantaneous images of backward facing step flow field, and then obtain the velocity field through the set-up of interrogation window and image analysis. And then obtain the vorticity calculated by central difference base on the measured velocity components.

The variation of the velocity profile is irregular in the reattachment zone, which occurs when flow passes a backward facing step. Hence, it is difficult to measure the flow characteristics using traditional measurement method, such as the pitot tube, hot film, and LDV. In this study, the CPIV method is adopted to measure the location of the reattachment point in the backward facing step flow. The velocity vectors of the flow field are also calculated. Finally, on the basis of experimental data and dimensional analysis, the effects of Reynold number (Re) and Froude number (Fr) on the reattachment length decreases as Re or Fr increases, and the regression formulas are following:

$$Xr / Hs = -0.9589Ln(Re) + 13.943 \quad ; \quad Xr / Hs = -1.0889Ln(Fr) + 5.2275$$