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Large scale particle image velocimetry measurement of river surface velocity based on images captured by a camera of the mobile phone

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In this research, we conducted LSPIV (Large Scale Particle Image Velocimetry) measurements to measure river surface velocity based on images recorded by mobile phone. The realization of this research is based on the developments of two products. The first one is the digital camera, which has been combined with the mobile phone after several years of development. The second one is the three-axis accelerometer, which can measure the attitude of the object. A three-axis accelerometer is one of the necessary parts of the mobile phone nowadays, as many functions of the mobile phone, such as step counting, Do Not Disturb mode, games, require the detection of attitude.

In LSPIV, there are nine parameters of the collinear equation. Three of parameters are the coordinates of the perspective center in the image space (focus distance d and image center position (u, v)), which can be determined in advance in the laboratory; the other three parameters are the coordinates (x, y, z) of the perspective center in real space, which can be set to (0, 0, 0); the last three parameters are the attitude of the camera (i.e., the mobile phone), which is determined by the depression angle, the horizontal angle, and the left-right rotation angle and can be measured by three-axis accelerometer. Therefore, river surface velocity could be analyzed by LSPIV with not only continuous images captured by a camera of the mobile phone but also the acceleration values obtained by the three-axis accelerometer when each image was captured.

In the present study, Yufeng gauging station, which is in the upstream catchment of the Shihmen Reservoir in Taiwan, is selected as the study site. Two other measurement methods were used to measure the river surface velocity and the comparison was conducted. One is using a handheld digital flow meter and another is using LSPIV with control points to calculate the parameters for measuring the river surface velocity.