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Application of Digital Close-Range Photogrammetry to Determine Changes in Gravel Bed Surface due to Transient Flow Conditions

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Abstract

In this study, Digital Surface Model (DSM) was created to investigate to what extent unsteady flow affects gravel bed surface in laboratory conditions. Bed elevation was measured before and after the passage of unsteady flow using a Digital Close Range Photogrammetry (DCRP) technique and the processing of photographic data was performed using PhotoScan software. From these preliminary outcomes, it can be concluded that the DCRP technique can be considered as a complementary method to track the changes of gravel beds at the laboratory scale.

Keywords: Digital Close Range Photogrammetry technique, gravel bed surface, Digital Surface Models, transient flow.

1. HYDRAULICS LABORATORY EXPERIMENT SETUP

The experiment was performed in a flume with glass side walls, and bed slope equal to zero in the Laboratory of Faculty of Environmental Engineering and Land Surveying, University of Agriculture in Kraków, Poland. Before every test, the bed material was levelled for 7.5 m with a thickness of around 12 cm. A total of 9 experimental runs were carried out under unsteady flow conditions in a 12-m-long, 0.485-m-wide, and 0.60-m-deep flow-recirculating tilting flume. The photo sessions were conducted with a photo camera set for native resolution (20 Mpix), following a photogrammetry technique similar to one proposed by Faezal et al. (2016) and Stojic et al. (1998). The bed material was classified as average gravel (d_{50} = 3.52 mm). The spatial coordinates (X,Y,Z) of control points (14 CPs) were acquired with a Topcon OS-103 total station. The CPs data was later used to calibrate both the 3D model and the contour plots derived from the DCRP.

A unit of Sony DSC-RX10M4 camera was mounted on a steel bar centrally above the flume width to capture a series of digital images of the channel bed. The distance from the bed has been fixed to 1.4 m and the camera was moved along the longitudinal profile of the flume with a 10 cm interval to capture 64 digital frames of the bed surface.

2. RESULTS

Pre-flow and post-flow bed surface models were compared to each other to determine the bed surface changes. Figure 1 displays the changes of the bed surface between pre-flow and post-flow conditions, for a test with a water discharge Q_{max} = 180 m^3/hand duration of 9′20″.

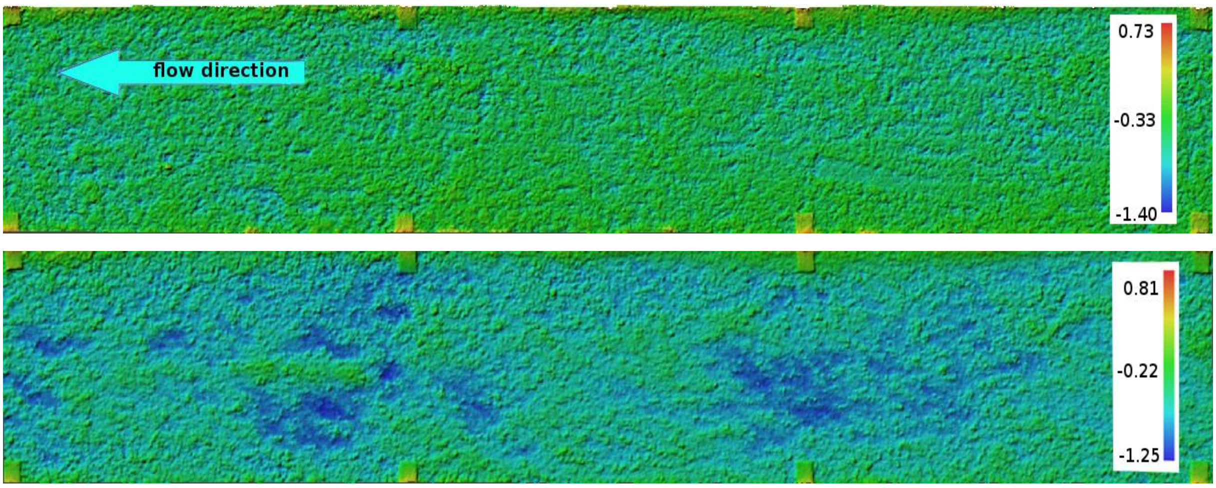

Fig. 1. The bed surface pre-flow (higher frame) and post-flow (lower frame), scale in cm.

The results show that the DCRP technique can be used to determine the bed surface changes, providing distributed information on erosion and accumulation zones. The comparison of pre- and post-flow DSM can also help in computing the total mass transport.

It is worth to note that the DSM have a sub-millimeter accuracy, while the flat sheets of paper used as CPs are reflected with very high accuracy.

References

Faezal, N., F.A.R. Mohd, L.R. Nurul, S. Radzuan, I. Zulkiflee, M. Mushairry, and A.H. Muhammad (2016), Monitoring laboratory scale river channel profile changes using digital close range photogrammetry technique, *Malay. J. Civil Eng.* **28**, 3, 252–266, DOI: 10.11113/mjce.v28.16012.

Stojic, M., J. Chandler, P. Ashrnore, and J. Luce (1998), The assessment of sediment transport rates by automated digital photogrammetry, *Photogramm. Eng. Rem. Sen.* **64**, 5, 387–395.

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