Riparian microtopography of Shonai River by applying pole-camera method

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Background

Excessive overgrowth of the riparian vegetation in Japan

The early stage of the overgrowth is produced by the entrapment of the fine materials by the pioneering plant (Harada, et al., 2015).

The UAV and the SfM-MVS

They are widely used to study the micro-scale topography and the riparian vegetation. However, restricted areas for UAV are expected to expand.

Purpose

This study proposed an alternative method (figure1) to capture images for the SfM-MVS.

The hydraulic mechanisms of transporting the fine sediment were then evaluated by calculating the local flow structures (The DSM obtained by the proposed method was used as the topographic data).

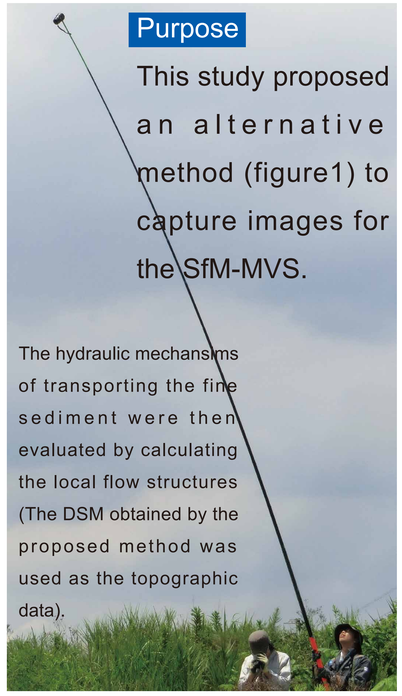

Figure 1. The “pole camera” method

Pole-camera method

The “pole-camera” method was oroginaly proposed in the field of the active fault research (Goto, 2015).

- The operator needs to rotate the pole and himself while the co-operator stands beside and captures images using a remote controller (Sony, RM-LVR2) (figure 2).
- The RTK-GNSS (Sokkia, GSX2) was used to obtain locations of the the ground control point (GCP).
- The SfM-MVS software (Agisoft, PhotoScan Professional edition, Ver. 1.2.6) was applied to obtain the digital surface model (DSM) and the ortho-images of the site (figure 3). The obtained DSM was used as the topographical data for the calculation.

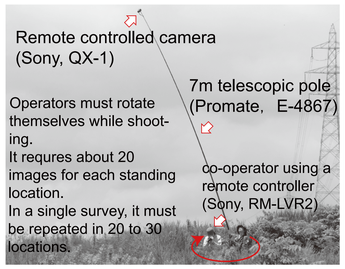

Figure 2. procedure of the “pole camera” method

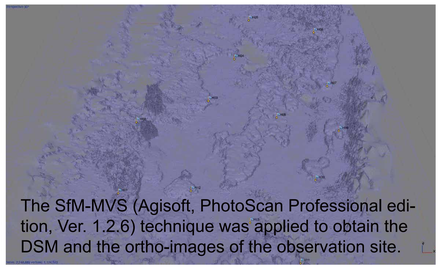

Figure 3. Example of the surfece of the DSM

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REFERENCES: Goto, H. (2015). Mapping of Fault Geomorphology Using "Structure from Motion - Multi - Video Stereo" Photogrammetry with Old / Hi-view Aerial Photography, Active Fault Research, No. 42, pp. 73-83. (in Japanese)
Harada, M., Nagayama, S., Oishi, T., and Kayaba, Y. (2015). Microtopography formation after flood-channel excavation in Ibi-River, Journal of Japan Society of Civil Engineers Ser. B1 (Hydraulic Engineering), Vol. 71 (2015), No. 4, pp. I_1171-I_1176. (in Japanese)

Observation site

The sandbars 28 km upstream from the mouth of the Shonai River in Japan (figure 4). The sandbar were excavated in 2012 to obtain a flat surface. Several flood events changed the landscape (figure 5).

Figure 4. Observation site of the study: 28 km upstream from the mouth of the Shonai River

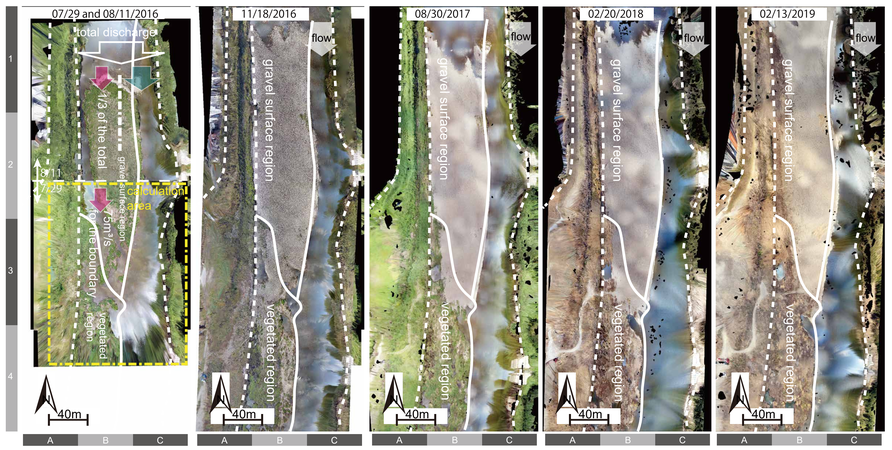

Figure 5. Ortho-rectified images of the site derived by the proposed "pole-camera" method (the calculation area and conditions are illustrated in the image on 07/29 and 08/11/2016.)

Numerical calculation procedure

Discahrge: 75 m³/s in the secondary channel (representing the small flood discharge illustrated by magenta colored arrows in figure 5).

Topography: the DSM previously obtained

Model: the customized version of Nays 2D of iRIC 2.1 (https://i-ric.org/en/).

(brief results are shown in figure 6)

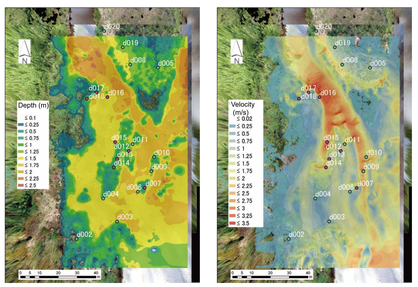

Figure 6. Calculated depth and velocity

Field observation

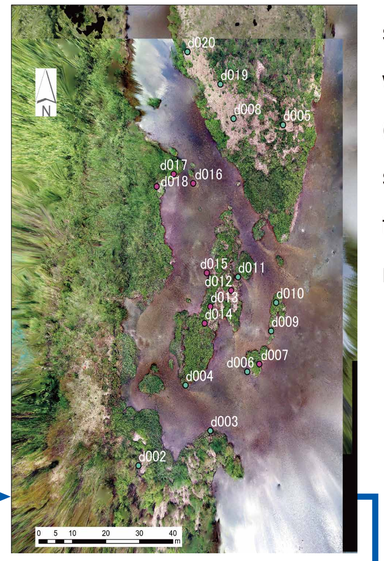

Figure 7. Sediment sampling locations on the ortho-image (8/11/2016)

The particle distributions (at sampling locations on figure 7) were classified into two groups (figure 8); one being the fine sediment group (green) and the other being the coarse material (magenta).

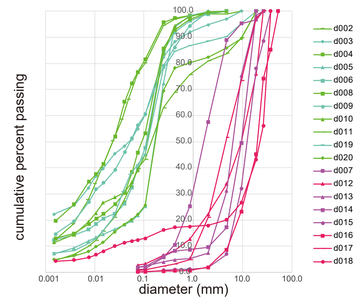

Figure 8. Particle distributions

Calculation results

The ratio of $u_{vegetation}$ (estimated flow velocity in the vegetated area) to w_s (1mm particle settling velocity) was evaluated (figure 9) based on the calculation results.

The colored areas denote the regions where the 1mm particles (relatively fine) were transported as suspended sediment (and not trapped). Most of the magenta markers (locations covered by coarse materials) were located in the areas of the colored contours.

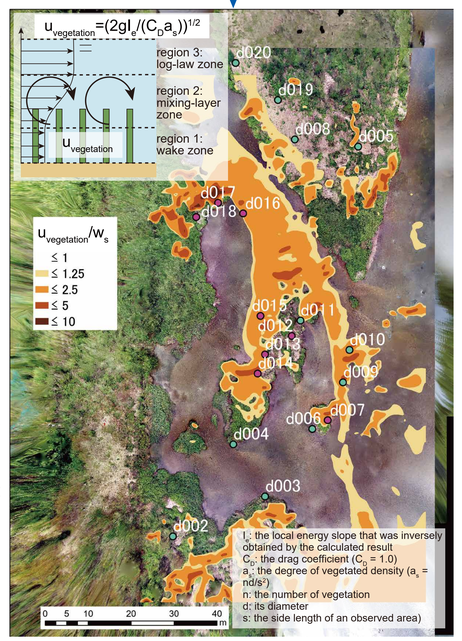

Figure 9. Contour of the ratio of $u_{vegetation}$ to w_s

Conclusions

- An alternative method to capture images for the SfM-MVS was proposed.
- The DSM was applied to a numerical calculation reproducing the flow structures.
- The estimated regions (without fine sediment deposits) were relatively consistent with the location where coarse materials were sampled on their surface.