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A METHOD OF AERIAL STIV WITHOUT REQUIRING OF GROUND CONTROL POINTS

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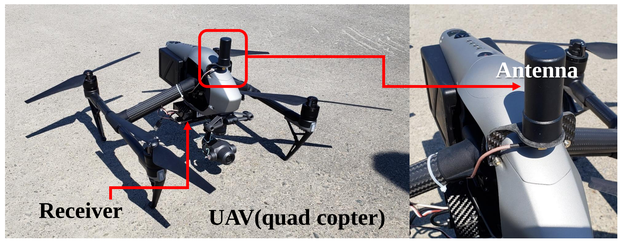
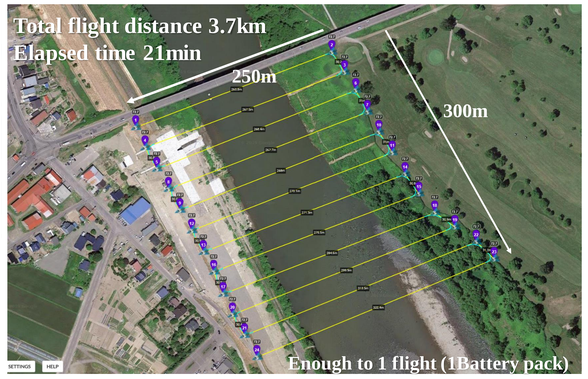
INTRODUCTION

By using a UAV (Unmanned Aerial Vehicle), it is possible to measure the river flow by image velocimetry wherever the place away. However, to perform image analysis, it is necessary to install the ground control point (GCP) in the image and to set the accurate coordinates to run a geometric correction. In this study, we extract as pseudo-GCP the point cloud of the 3D terrain model, which was made by Structure from Motion (SfM) using a post-processed kinematic system by UAV. After we analyzed the surface velocity distribution by Space-Time Image Velocimetry (STIV) method.

THE METHOD OF AERIAL STIV WITHOUT GCP



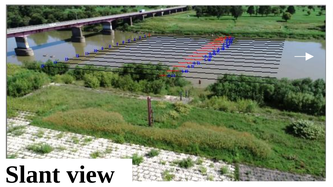


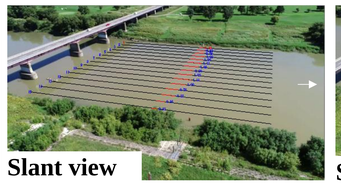
A post-processing kinematic system “Klau PPK system(Klau Geomatics)” compatible with UAV of “Inspire2(DJI)” .Electronic reference information is imported by post-processing.

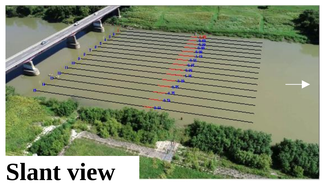
UAV zigzag flight of 70% side laps and 85% overlap was able to create a 3D terrain model.

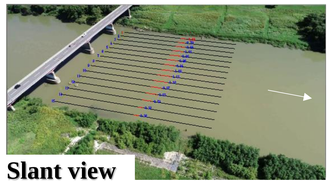
It was possible to about 20 minutes flight to create a terrain model of 300m × 250m.

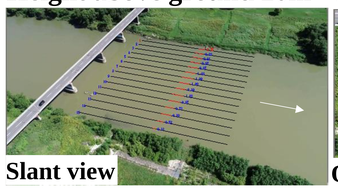
COMPARISON OF VELOCITY IN DISTRIBUTION MULTI-ANGLE IMAGE（Slant view or Ortho view)

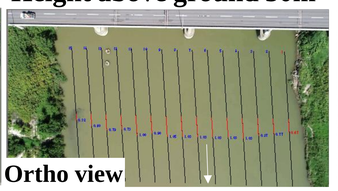


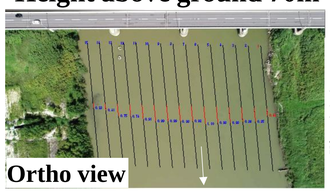


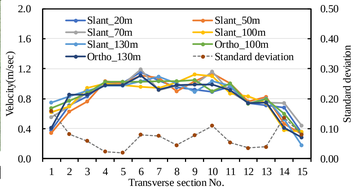




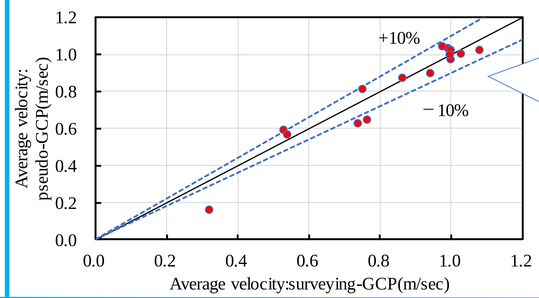




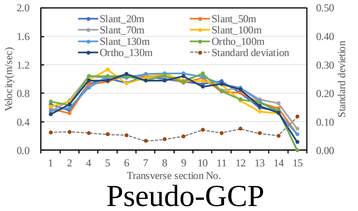




Surveying-GCP

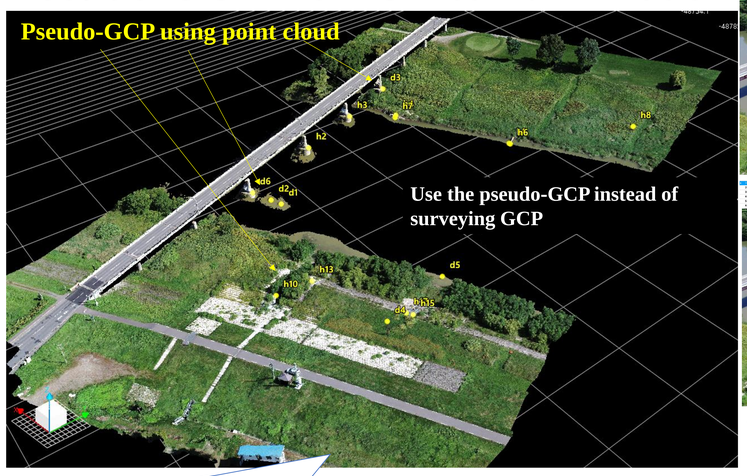


The difference in surface flow velocity was within approximately 10% between surveying-GCP and .Pseudo-GCP



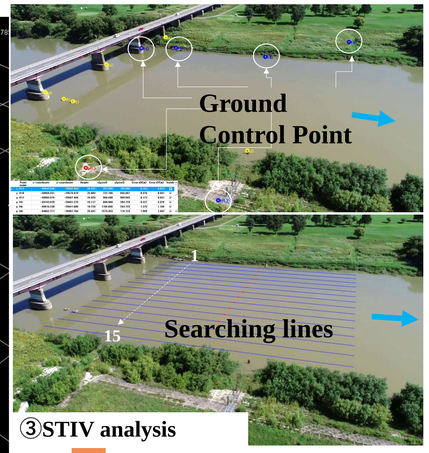
Pseudo-GCP

Pseudo-GCP from 3D terrain model



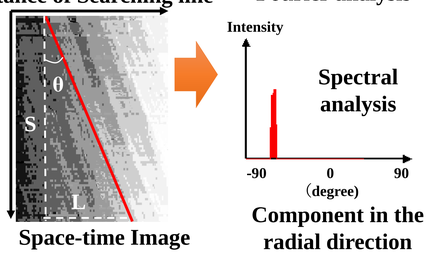
- The three dimensional terrain model was created using SfM/MVS, the plane position error at the distance was from 0.05m to 0.09 m and the height error was from 0.01m to 0.04m.
- The authors extracted the pseudo-GCP from the point cloud.

① Set the GCP(Ground Control Point) on the image



②Geometric correction & set the searching lines

③STIV analysis

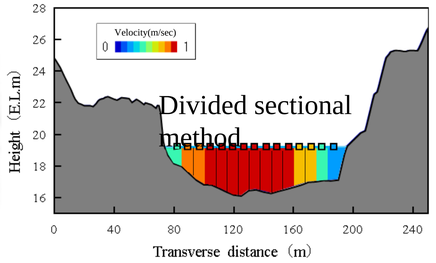


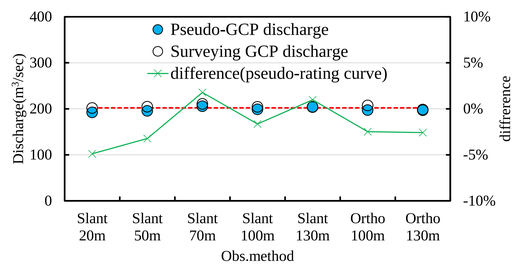
STIV method

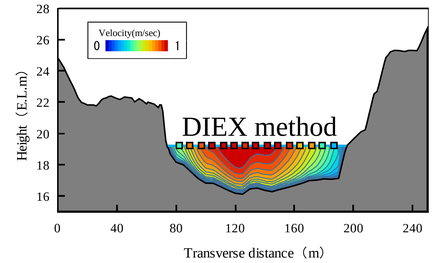
$$U = \frac{S_x}{S_t}\tan\emptyset$$

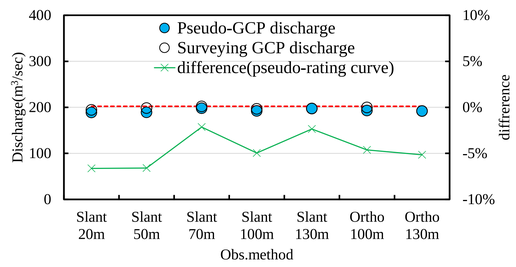
Where U [m/s] is velocity, S*x* [m/pixel] is the unit length scale of the line segment, S*t* [s/pixel] is unit scale of time axis, ∅ is angle of STI.

COMPARISON OF 2 TYPE DISCHARGE RESULTS









- A comparison of the discharge between using the pseudo GCP and surveying-GCP was shown that the difference was within ± 5%, regardless of the divided sectional method or DIEX (Dynamic Interpolation and Extrapolation) method.

CONCLUSIONS

The authors succeeded to calculate surface flow velocity with the minimum error by the STIV method using pseudo-GCP which is no requirement of surveying-GCP.