

Spatiotemporal analysis of topography and vegetation in check dams using RTK-UAV and SfM-MVS photogrammetry

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In the world mountain and forest streams, the construction of soil erosion control dams (also called check dams or Chisan-dams; hereinafter called “Chisan-dam”) has been widely applied to stabilize the sediment movement of the river basin. Despite the number of constructed Chisan-dam more than 35000 in Hokkaido (Tamate & Hayajiri 2008), there are few reports of quantitative evaluation of whether the topography changed as planned or how the forest vegetation changed after the establishment. Therefore, it is needed to conduct an efficient survey of many Chisan-dams and assess whether the topography and vegetation are changing as planned.

Unmanned Aerial Vehicle (UAV) photogrammetry and structure-from-motion multi-view stereo (SfM-MVS) photogrammetry are widely applied due to the advantage of obtaining Digital Surface Model (DSM) at relatively low cost. Whereas, the accuracy of the model varies because it is difficult to set Ground Control Points (GCPs) uniformly such as small forest basin. In October 2018, the DJI Phantom 4 RTK unmanned aerial vehicle (RTK-UAV) was launched with direct integration of the Real Time Kinematic - Global Navigation Satellite System (RTK-GNSS). The aerial images of RTK-UAV records highly accurate position information via RTK-GNSS, and it is possible to acquire high-precision DSM without installing GCPs even in forest areas with many undulations and obstruction (Nakata et al. in press).

The aim of this study was to measure the change of longitudinal gradient before and after the construction of a Chisan-dam constructed in 1985. After restoring the vertical slope before construction from the design drawing of 1985, a vertical survey using a total station was conducted at the same site in August 2019. In addition, we verified the possibility of construction of a high-resolution DSM model without GCPs using the RTK-UAV.

As a field survey using total station, the riverbed 34 years after the Chisan-dam construction was equal to the height of the sedimentary surface, and it was achieved the planned gradient. On the other hand, the riverbed below the Chisan-dam was scoured by about 1 m more than before its construction. Result of investigating the flight conditions of the RTK-UAV, a DSM model with a resolution of 2.67 cm / pix was constructed without using GCP. In the presentation, the validity of the RTK-UAV survey will be discussed by comparing the data obtained from the field survey with the data extracted from the DSM.

Keywords: check dam, UAV-SfM, RTK-UAV, topography, vegetation