Monitoring Technology to Support Volume Reduction Construction of Dredged Sediment

Chika Ito *[1], *Satoshi Nishiyama*[1], *Naoko Sakamoto*[1]

[1] *Okayama University*

To maintain the functionality of ports and harbors, the increasing size of vessels should be considered. Currently, there is a shortage of disposal sites and reclaimed land for dredged sediment generated by the deepening and maintenance of channels and anchorage areas. For this reason, volume reduction construction is being conducted to extend the life of the disposal site and increase its receiving capacity by accelerating consolidation settlement. However, the current method of monitoring volume reduction construction is qualitative, using water level gauges. Therefore, in this study, we focused on Unmanned Aerial Vehicle (UAV) surveying equipped with a green laser scanner, which has the characteristic of penetrating underwater, among various methods to establish an efficient and effective monitoring technique to support volume reduction construction. UAV green laser surveying irradiates a laser beam and obtains the distance of the reflected location as 3D coordinate data. By doing this, seamless measurement from the ground to below the water's surface is possible. First, to verify the accuracy at a sediment disposal site where it is difficult to install adjustment points, we verified the accuracy with no correction by adjustment points. The results of the measurements from the aspects of water quality, sediment quality, and turbidity of the sediment disposal site were summarized, and the methods of utilization and future issues were discussed. As a result of the accuracy validation, the range average and RMSE of the ground survey data and the UAV green laser measurement data met the accuracy of ±70mm.Therefore, it is considered applicable to ground surveying for volume reduction construction, which requires an accuracy of 10 cm. In addition, we prepared test pools with different conditions and compared the point density of lasers at the bottom of the pools to verify the effects of sediment disposal site-specific water quality, sediment quality, and turbidity on the measurements. The results showed that water quality and turbidity adversely affected the measurements. The field measurements were taken at three different altitudes, and it was found that the higher the altitude, the more the laser reached the bottom of the water. We considered that the increase in depth measurement capability with altitude might be related to the expansion of the spot radius of the green laser beam, so we fixed the altitude and expanded the beam divergence angle for measurement. The results showed that the laser reached deeper depths as the beam divergence angle increased, and measurements could be taken down to a water depth of about 1 m when the beam divergence angle was 4.0 mrad. Therefore, it is considered effective to increase the spot radius of the laser beam to improve the depth measurement capability at sediment disposal sites.

Keywords: Green laser, UAV, Dredged sediment disposal site, Volume reduction