3D Monitoring of Coastal Erosion Control Structures Using UAV

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

[1] *Graduate School of Environmental and Life Science, Okayama University*

Japan, an island nation, has approximately 34,000 km of coastline, which is significantly longer per unit area of land compared to other countries. Coastal areas are prone to disasters, and in Japan's case, coastal erosion is a significant problem. It has been exacerbated by factors such as rising sea levels due to global warming. As a result, approximately 160 hectares of land are lost annually, making the efficient inspection of coastal protection facilities a critical issue. To address this, coastal erosion countermeasures such as breakwaters and artificial reefs have been installed nationwide. In order to assess the condition and effectiveness of these structures, it is essential to efficiently understand the shape and condition of the seabed and coastal structures.

Currently, visual inspections are the primary method used, but with the recent push for construction digitalization, there is a demand for more efficient, unmanned, and labor-saving inspection methods. Narrow multibeam acoustic depth measurement and airborne laser depth measurement are used for monitoring underwater structures that cannot be visually inspected. However, there are challenges in terms of measurement difficulties in certain locations and cost considerations. In this study, we conducted surveys with drones equipped with a green laser scanner that penetrates underwater to understand the basic performance and identify the changes in wave-dissipating blocks (tetrapods) over two periods using the Iterative Closest Point (ICP) method.

As a result, it was found that the basic performance of drone surveys varies greatly depending on factors unique to the area under consideration, such as the influence of waves. It can detect depressions of approximately 50 cm in submerged breakwaters located 3 meters below the water surface. In the extraction of changes in wave-dissipating blocks, it was possible to identify an overall subsidence of approximately 34 cm and localize the movement of individual blocks. From these findings, drones can be expected to be utilized as a screening method for inspection and diagnosis to identify overall changes and abnormalities in structures that are difficult to capture visually.

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