**Segmentation and Feature Classification of Point Clouds Acquired by　LiDAR-SLAM in Urban Rivers**

Tetsu Yamaguchi1\*, Naoto Kimura1, Takeshi Komori2, Nobuaki Kubo2, Etsuro Shimizu2, Masafumi Nakagawa1

1Shibaura Institute of Technology, Japan

2Tokyo University of Marine Science and Technology, Japan

\*mh23033@shibaura-it.ac.jp

***ABSTRACT***

In urban crowded and narrow rivers, high-resolution 3D maps can assist the navigation of autonomous boats with GNSS positioning and 3D scanning. In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is promoting the "project PLATEAU", which is a project to develop 3D maps of urban river areas. However, compared to land areas such as roads and structures, 3D mapping of river areas is still difficult to obtain data, and is still insufficient in many aspects. Therefore, this study aims to develop a map of urban rivers and implement our proposed methodology on autonomous boats. In this study, we proposed a method for the segmentation of point cloud data acquired by a handheld SLAM-LiDAR and water-borne Mobile Mapping System (MMS) on a river as a step in the mapping of urban rivers. The proposed methodology consists of two steps. The first step is point cloud acquisition using a handheld SLAM-LiDAR and water-borne MMS on a boat in urban river environments where GNSS signals are unstably received. The second step is a semantic segmentation of the acquired point clouds to be used for the Geographic Information System (GIS). In our experiments, we confirmed that revetments, river crossing structures, and piers of urban expressways can be measured by a handheld SLAM-LiDAR and water-borne MMS from rivers. We also confirmed that revetments and piers of urban expressways were extracted with an accuracy of approximately 60%. Some in-river structures of urban expressways were not completely extracted. Since the accuracy of attribute information depends on the results of point cloud acquisition, several technical issues remained in object recognition and segmentation of point clouds. The first issue is the lack of feature points due to the limitation of measurement angle and position from the boat. The second issue was vibration caused by water waves in laser scanning.

**Keywords:** Point clouds, Segmentation, Simultaneous Localization and Mapping (SLAM), Rivers, Geographic Information Systems