A Study on Efficiency Increase in Road Management Using Point Group Data

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ITOUJI Toshiro, Senior Researcher, SEKIYA Hirotaka (Ph. D.), Head, KONNO Arata, Researcher, KITAGAWA Daiki, Guest Research Engineer MORITA Kenji, Guest Research Engineer

Information Platform Division, Research Center for Ifrastructure Management

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1. Introduction

For the purpose of speeding up the examination process for permitting the passage of oversize/overweight vehicles on roads, etc., the Ministry of Land, Infrastructure, Transport and Tourism (the "MLIT") has been collecting three-dimensional data on ordinary roads since August 2018, including roads managed by local governments, by installing sensing equipment in the road management vehicles of Regional Development Bureaus, etc.

In this study, in view of utilization of this data as well for upgrading and efficiency increase of road management, we assumed detection of potholes, which are frequently created, out of the items of "checking road surface deformation," use of which is highly needed by on-site offices, and conducted an experiment to clarify the relationship between traveling conditions, such as traveling position and speed at measurement, and detectable size.

2. Collection of 3D point group data

Based on the depth and size of potholes analyzed from the annual patrol log kept in the office, 15 types of potholes were created on the test course. 3D point group data was collected from the vehicle equipped with the sensing device (MMS-AT220) owned by the Kanto Regional Development Bureau, which run on the test course in 9 patterns, two times for each pattern, in combination of 3 patterns of traveling speed (20 km/h, 40 km/h, 60 km/h) and 3 patterns of traveling position (normal lane, adjacent lane, and opposite lane were expected) (Fig. 1).

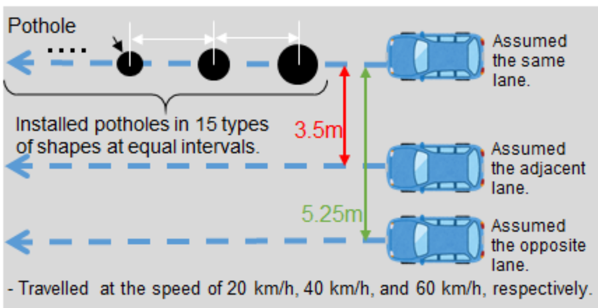

Fig. 1: Outline of the experiment

3. Analysis using pothole detection methods

Four types of methods (RANSAC, PCA (principal component analysis), scan line tracing, and point group density variation) were used for analysis, and parameters were adjusted to optimize the ratio of detection / misdetection of potholes for each method. Of these methods, when the RANSAC method was used, the optimum ratio of detections and misdetections in areas other than planted area was obtained when traveling on the same and adjacent lanes, although there was misdetection of planted area. Accordingly, as an example of analysis results using this method, Table 1 shows the results of detection of potholes in the shape specified in the same Table.

Table 1: Results of detection of mortar-shaped potholes, 20 cm in diameter and 5 cm in depth.

20cm / 5cm / 10cm		Travelling position		
		Same lane (0 m)	Adjacent lane (3.5 m)	Opposite lane (5.25 m)
Traveling speed	20km/h	○	○	×
	40km/h	○	△	×
	60km/h	○	△	×

○ : Detected at both times △ : Detected once.
× : Not detected.

The following knowledge was obtained: "Potholes on the same lane are detectable even in high speed traveling (60 km/h)", "It is necessary to travel at a low speed (20 km/h) to detect potholes on adjacent lane certainly", and " "Potholes on the opposite lane cannot be detected even when traveling at a low speed (20 km/h)."

4. Future development

We intend to specify conditions for use by Regional Development Bureaus in road management by clarifying the relationship between traveling conditions and detectable size in the fields other than potholes, including detectable conditions based on the difference in the performance of sensing equipment (point group density) and slope deformation.