Project Title:	Study of Artificial Intelligence for Road Surface Depression Detection Using 3D LiDAR Data
Principal Investigator (PI):	Prof. WONG Man Sing
Project ID:	CICR/01/21
Research Institution:	The Hong Kong Polytechnic University
Industry Partner:	Highways Department, HKSAR Government (HyD)
Subject Area:	Construction Productivity
Duration:	18 months

Background

Traditional 2D image-based analysis for pavement defect detection is often unable to discriminate dark areas which were not caused by pavement defects such as shadows, poor illumination, etc.. Moreover, the 2D methods cannot detect some defects with lacking the depth information. The 3D LiDAR data has been demonstrating its ability to obtain the depth information and less vulnerable to lighting conditions. The 3D LiDAR technology has become a promising approach to automate detection of road pavement surface depression in recent years.

Existing algorithms can only detect a single type of defect pattern on pavement surface (e.g., rutting or cracks), but in high-resolution 3D pavement data, the road surface depression includes rutting, and potholes are all obvious and detectable. Thus, in view of practical application, it is necessary to develop methods that can detect multiple defects from the 3D pavement data. The challenge of automatic road surface depression detection is to achieve high accuracy under various complex environments consistently. In order to ensure driving safety amid the current research status, it is a priority to innovate a set of new methods to extract various road surface depression from 3D pavement data simultaneously, i.e. rutting, potholes, and shoving.

The Survey Division of HyD is utilizing the Vehicle-based Mobile Mapping System (VMMS) to capture photos and 3D LiDAR point clouds of carriageways and surrounding environments. Such deliverables can help engineers to identify road defects in high resolution at about centimetre level. In recent years, artificial intelligence (A.I.) technologies began to show strong automation and superior performance in automatic 2D and 3D pavement depression detection. Therefore, this project collaborates with the HyD to develop an A.I. for road surface depression detection using 3D LiDAR data captured by VMMS to detect the defects accurately, efficiently and effectively. The deliverables developed in this project can be further extended to other applications, for example, detecting the defects in airport runway and the roadside pavement, as well as the defects on vertical surfaces, e.g. building facades.

Objectives

i) To develop an Artificial Intelligence (A.I.) for road surface depression detection using 3D LiDAR data;

ii) To devise the Hong Kong first-ever 3D point cloud library of road defects; and

iii) To develop a set of tools for road surface depression detection.

Key Deliverables

⬥ A set of robust road segmentation algorithms

⬥ An A.I. road surface depression detection algorithm

⬥ A 3D point cloud library for the defects,

⬥ A set of tools for the detection

⬥ An user guideline, a manual and standard to detect the defects.