

B-DASH: Feasibility Study on the Practical Application of Screening Technologies: Vehicle-type Ground Penetrating Radar System and AI-based Cavity Detection System

(Research of FY 2020-21)

1. PURPOSE

This feasibility study aims to develop a screening manner using cavity detection by Vehicle-type Ground Penetrating Radar System for sewers' problems and AI-based image analysis. This feasibility study was selected for the B-DASH project 2018 of the Ministry of Land, Infrastructure, Transportation, and Tourism (MLIT.) The research consortium of Kawasaki Geological Engineering Co., Ltd. and JS conducted the study as an entrusted research of the National Institute for Land and Infrastructure Management (NILIM.)

2. Outcomes of this year

As figure 1 shows, the technology recognizes abnormal signs from the Ground Penetrating Radar System as might be cavities. The exploration continues for three months to detect the changes in pits, such as moving to upper or new holes. The detected abnormal areas were used to screen the sewer degradation.

The outcomes of this year are as follows.

1. The repeated radar exploration found cavities' abnormal changes at 13 places. The survey was conducted at four locations out of 13 during the

FS period and found all sites had holes. The event showed the system was adequate for cavity detection.

2. The investigation of nearby sewers around the abnormal signal area with an inside TV camera found 21 inside sewer problems relating to road sinkage out of 27. Besides, at the places where cavities' odd change was recognized, sewers within one meter from cavities showed abnormalities. This event suggested the technology can be used for sewer screening investigation.

3. Figure 2 shows that AI technology detected more abnormal signals than engineers. Besides, AI saw 83 abnormal signs out of 84 detected by engineers.

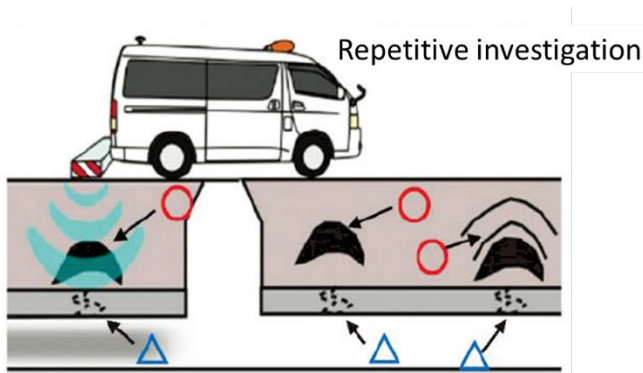


Figure 1. Image of cavity detection by vehicle-type ground penetrating radar system

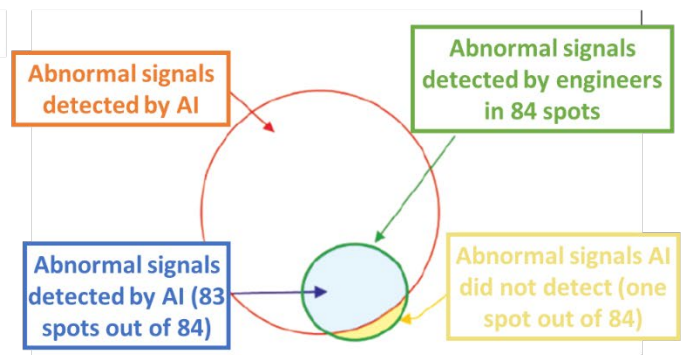


Figure 2. Abnormal signal detection by AI

3. Conclusion and Future Issues

The feasibility study verified Vehicle-type Ground Penetrating Radar System was effective for cavity detection. The technology suggested it could be used for sewer screening because it found inside sewer abnormality relating to road sinks at places with abnormal changes. While AI technology showed it could detect abnormal signals, its detection precision is still low and need to improve through repetitive studies.

The feasibility study exposed that abnormal signals can verify that cavities exist. On the other hand, we need to know the characteristics of abnormal movements to judge if sewers' cavities cause the signs. In the future, we need more data, including geology and sewer existence, to expose the characteristics of sewer-related holes. Besides, surveys for the long-term quantitative transition of abnormal signals by continuous measuring at the same place are required to know the frequency of radar detection.

Keywords: **Ground Penetrating Radar, Cavity detection prediction, Screening, AI**