Enhancing Road Safety by Infrastructure Health Monitoring using Mobile Mapping System

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Improving road safety via monitoring the performance of road pavements is crucial. Recently, studies related to road condition inspection and safety improvement using infrastructure health monitoring (IHM) techniques are being actively conducted in developed countries. IHM has been widely applied in various engineering sectors due to its ability to respond to adverse structural changes, improving structural reliability and life cycle management.

The development of the deterioration model of road condition is a key process of longterm life cycle cost analysis. In this study, a novel method for monitoring road pavements using a mobile mapping system (MMS) and a deep learning crack detection system was presented. MMS is a technology for acquiring high-quality spatial information data by mounting a receiver, GNSS, laser scanner, and digital camera in a vehicle. In this paper, the deep learning system uses the YOLO-v2 algorithm to automatically determine the condition levels of the road pavement surface. Furthermore, this study estimated life expectancy of the crack of asphalt road pavement using the Bayesian Markov Mixture Hazard Model. For the construction of deterioration model, national highway pavement monitoring data for about 10 years from 2007 to 2017 was used.

In addition, in order to accurately estimate life expectancy, environmental variables such as traffic volume, equivalent single axle loads (ESAL), structural number of pavement (SNP), meteorological condition, and deicing were applied to retain reliability of the estimation results. Furthermore, an optimal maintenance method through economic analysis was presented targeting the pavement section of Sejong city, South Korea. The road surface condition rates are divided into 5 levels. As a result of monitoring the pavement conditions, it was confirmed that national highways which are systematically maintained and managed through the pavement management system (PMS) are managed relatively well compared to roads managed by local governments. It can be confirmed that timely management leads to an extension of life expectancy of road sections. In addition, economic analysis using the pavement deterioration model showed that the preventive maintenance method is the most economical in terms of maintenance costs and user benefits. The results of this study are expected to be used as fundamental reference for infrastructure management plans.

Keywords: Infrastructure Health Monitoring, Mobile Mapping System, Deterioration Model, Bayesian Markov Mixture Hazard Model.