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Research Summary: AY2019

Pavement roughness identification utilizing a moving vehicle

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【Background】

Pavement roughness is one of the important indicators which represents conditions of roads or bridges. By keeping pavement roughness as smooth as possible, not only riding comfortability of cars but also a lifespan of roads and bridges can be increased. The method to identify pavement roughness by utilizing acceleration data measured on a moving vehicle has been developed in recent years, which is so-called a drive-by method. The drive-by method can reduce costs and labors more than existing methods, however it is hard to secure high accuracy.

【Objective】

In this study, an accuracy of several methods for identification of pavement roughness using only accelerometers attached on the measurement car is investigated by simulation and experiment.

【Approach】

Investigated five methods are named as DP+LC, PIM+LC, PIM +EM, PIM +LC(L1) and KF. A least square minimization with L_2 norm regularization is applied in DP+LC, MP+LC, and PIM +EM. A least square minimization with L_1 norm as regularization term is applied in PIM +LC(L1). A difference between DP and PIM is how to solve the least square minimization. In the DP the least square minimization is solved by dynamic programming and in PIM it is solved by using a pseudo-inverse matrix. In KF, Kalman filter method is used.

【Publication plan】

・EURODYN 2020 XI International Conference on Structural dynamics

【Results】

Details of 5 methods investigated in this study is shown in Table 1.

Table 1: Details of identification methods

Method name	Basic method	Solution	Regularization parameter determination	Regularization term
DP+LC	Least square minimization	Dynamic programming	L-curve	L_2 norm
PIM+LC	Least square minimization	Pseudo inverse matrix	L-curve	L_2 norm
PIM+EM	Least square minimization	Pseudo inverse matrix	EM algorithm	L_2 norm
PIM+LC (L1)	Least square minimization	Iterative thresholding algorithm	L-curve	L_1 norm
KF	Kalman filter	-	-	-

Calculated errors by 5 methods with 100 types pavement are shown in Fig.1. the input accelerations were calculated by simulation and the error values are average value of 100 pavements errors. DP+LC(L1) has the highest accuracy among 5 methods by simulational investigation.

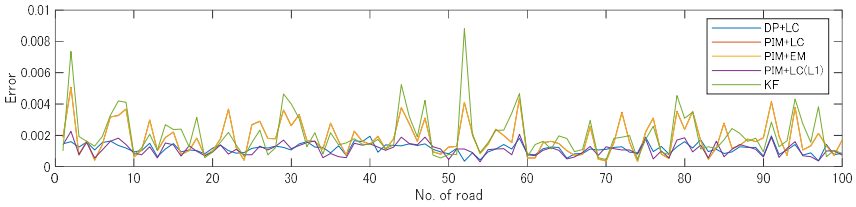

Fig.1: Error of 5 methods by simulation