Development of a Damage Detecting Method for RC Slabs by Means of Machine Learning

Yutaka Tanaka and Takahiro Nishida

Port and Airport Research Institute, 3-1-1, Nagase, Yokosuka, 239-0826, JAPAN, tanaka-yu@p.mpat.go.jp, nishida-ta@p.mpat.go.jp

Keywords: AE, Non-Destructive Method, Machine Learning, Damage Detection, RC Slab.

1 Introduction
It is beneficial to understand damage conditions of RC structural members by non-destructive methods for long term use of RC structures. Capturing AE signals is one of the effective methods to detect the damaged position and area in the structural member. In the previous research, Nishida et al. (2019) developed an aggregation detector. The detector is equipped AE sensors to capture AE waves generated by the internal damage of the RC bridge deck. Nishida et al. focused on the AE energy in order to detect the damaged area and they proposed the method to decide the threshold value of AE energy to judge the damaged area. In this study, authors applied a K-means clustering method (MacQueen, 1967; Arthur and Vassilvitskii, 2007) to the AE wave data that was obtained in previous research. The aim of this study is to develop a damage detecting method for RC slabs with machine learning.

2 Analysis of AE waves
In this study, the AE wave data obtained in the previous research (Nishida et al., 2019) was analyzed. The AE wave data was separated into a group by 1.0 m for each measurement line. Authors focused on the frequency domain of AE waves. The power spectral density (PSD) of each AE wave was calculated and averaged in each group. In this study, the averaged PSDs were regarded as the representative values of each group and selected as the input data for the K-means clustering method.

3 Results
Figure 1 (a) shows the PSD of the centroid of each cluster when the number of clusters was 2. The peak frequency and value of each PSD were different. Figure 1 (b) shows the scatter plot of each group. In Figure 1 (b), the number located beside each plot is the line number. In Figure 1 (a), the peak frequency of the cluster 1 was different from that of the cluster 1. In Figure 1 (b), the all data belong to the cluster 2 was in the line 6 where a lot of defects were observed in the visual and the hammering inspection that had carried out in previous research. From this result, the data was separated into the obviously damaged group and the other group, and the peak frequency of the PSD in the damaged area became lower than that in the other area.
4 Conclusions

Following conclusions were derived from this study.
- From the result of the K-means clustering, the data was separated into the obviously damaged area and other areas. In addition, the characteristic of the power spectral density of the centroid of the damaged cluster was different from those of other clusters.

ORCID

Yutaka Tanaka: https://orcid.org/0000-0002-9685-1330
Takahiro Nishida: https://orcid.org/0000-0002-2018-6928

References

