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Acoustic Emission based Crack Localization using Convolutional Neural Network

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ABSTRACT

Structural deteriorations in construction industry have always been a concern due to aging structures. Especially, the deterioration of structures such as nuclear power plants can cause serious social and economic problems. Traditionally, the location of damages such as the cracks in the nuclear power plants in the early stage are being detecting using acoustic emission (AE) sensors. The most popular methods for estimating the crack locations are time of arrival (TOA), time difference of arrival (TDOA), and Received Signal Strength Indicator (RSSI). Along with the development of artificial intelligence and deep learning techniques, researchers have recently proposed new damage detection methods using CNN models. However, these networks are mostly for classifications; can estimate the location from the candidate but not by coordinates. Furthermore, most of these methods are single input single output (SISO) model. Therefore, we propose a new multi-input multi-output regression CNN model using AE sensors to automatically estimate the location of the damage. The proposed method is divided into two phases. First, the signals from AE sensors were collected, and transformed to continuous wavelet transform (CWT) images. Second, a Convolutional Neural Network (CNN) was designed to localize the damage by using the CWT images. The AE signals from experimental test was conducted in a rectangular concrete beam with artificially generated damages. The results express that the proposed method is an effective and progressive method.

KEYWORDS: acoustic emission sensor; deep learning; convolutional neural network; damage detection, structural health monitoring

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