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Deep Learning based Automatic Peak Picking Method for Structural Modal Analysis

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ABSTRACT

Many civil infrastructures around the world have been constructed more than 50 years ago, and issues have been reported due to deterioration. The maintenance of a structure is mostly performed through exterior inspection by an expert but takes a lot of time and the results may be subjective. Vibration-based structural health monitoring (SHM) is used to ensure the safety of structures by installing sensors in structures. The peak picking method, one of the applications of SHM, is a method that analyze the dynamic characteristics of a structure. However, the results may vary depending on the person predicting the peak point; further, the method does not predict the exact peak point in the presence of noise. To overcome the limitations of the existing peak picking methods, this study proposes a new method to automate the modal analysis process by utilizing long short-term memory (LSTM), a type of recurrent neural network. The method proposed in this study uses the time series data of the frequency response function (FRF) directly as the input of the LSTM network. In addition, the proposed method improved the accuracy by using the phase as well as amplitude information of the FRF. Simulation experiments and lab-scale model experiments are performed to verify the performance of the LSTM network developed in this study. The result reported a modal assurance criterion of 0.8107, and it is expected that the dynamic characteristics of a civil structure can be predicted with high accuracy using data without experts.

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