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Vibration-Based Structural Damage Identification Using Deep Convolutional Neural Networks- A Review

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Civil engineering structures are subjected to damage and natural hazards during their service life, which affects the safety and functionality of the structure or even collapses. Structural health monitoring (SHM) is the main method to deal with the identification of damages in civil structures. Damage detection of structures plays a substantial role in the reliability and preservation of the service life of structural systems. The need to observe damages in structures has led to the development of several detection techniques. Recently, vibration-based methods have been used to detect damage using the vibration response of the structure. Artificial intelligence (AI) techniques have been receiving increasing consideration as an effective solution for damage detection using vibration data. Convolutional neural networks (CNNs) which are feedforward artificial neural networks (ANNs) with periodic convolutional and subsampling layers have been developed rapidly. With growing computational abilities in the era of big data, high-performance computing, parallel processing, and cloud computing, CNNs as a popular class of deep learning methods have demonstrated important developments in remote and autonomous structural health monitoring of critical civil infrastructure. This paper presents a review of current convolutional neural networks to identify damage in civil structures using vibration data due to the great potential of their application. A brief introduction of the deep CNN algorithm is presented first. Then, an extensive review of the application of CNNs for structural damage identification using vibration data is given. In this review, the advantages and limitations of deep CNNs, as well as some new research trends, are addressed.