Damage Identification of a Concrete Arch Beam Based on Frequency Response Functions and Artificial Neural Networks

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ABSTRACT: This paper presents a vibration-based structural health monitoring (SHM) technique for the identification of damage in a concrete arch beam replica section of the Sydney Harbour Bridge. The proposed technique uses residual frequency response functions (FRFs) combined with principal component analysis (PCA) to form a damage specific feature (DSF) that is used as an input parameter to artificial neural networks (ANNs). Extensive laboratory testing and numerical modelling are undertaken to validate the method. In the proposed technique, FRFs are obtained by the standard modal testing and damage is identified using ANNs that innovatively map the DSF to the severity of damage (length of damage cut). The results of the experimental and numerical validation show that the proposed technique can successfully quantify damage induced to a concrete arch beam simulating a real life structural component of the Sydney Harbour Bridge.

Keywords: Structural health monitoring, Damage detection, Sydney Harbour Bridge, Frequency response functions, Artificial neural network, Non-destructive testing, Principal component analysis