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Bridge Health Monitoring Using Two Stage Neural Networks

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Abstract

In this paper a method for damage identification in bridges employing neural networks is presented. In this work, in order to increase the speed and reduce the computational error for damage detection a new two stage method is introduced. In the first stage the damages are localized using a radial basis function neural network which has the benefit of high learning speed. In the second stage, the exact location and severity of damaged elements found using a well-trained back propagation neural network which possesses high powerful learning capacity. In order to evaluate the proposed method Louisville truss bridge in United States of America is modeled by a finite element program and then changes in the responses is analyzed using MATLAB neural networks toolbox. Numerical results demonstrate the efficiency of the proposed method for correct damage identification.

Keywords: damage detection, neural networks, modal analysis, truss bridge

1. Introduction

Recent large earthquakes have shown that the structures in general are not completely protected against these events. When damage is not evident, it is useful to have information about the state of the structure, which is crucial in the case of important and public buildings as hospitals, communication centers, etc. If a severe damage is found, an immediate evacuation of people is pertinent, so as to prevent risks derived of aftershocks or posterior earthquakes. If low damage is predicted, the building can be returned to use reducing the economic effect of the earthquake [1]. Damage to a structure may be caused as a result of severe natural events such as earthquakes and cyclones, accidents or degradation of materials. Sometimes the extent and location of damage can be determined through visual inspection. But visual inspection has an inadequate capability to detect and assess the damage, especially when damage lies inside the structural member and is not visible. Therefore, an effective and reliable damage assessment methodology will be a valuable in timely determination of damage and deterioration state of structural member [2].

One of the most important aspects of evaluation of structural systems and ensuring their lifetime safety is structural damage detection. This theme is related to the fact that the number of damaged or deteriorated structures grows rapidly in many countries. The majority of the identification techniques involve the use of the measured structural responses under dynamic excitation. Damage causes changes in structural

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