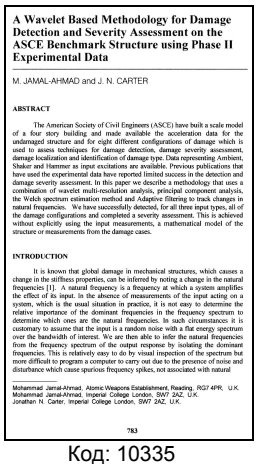

A Wavelet Based Methodology for Damage Detection and Severity Assessment on the ASCE Benchmark Structure using Phase II Experimental Data

M. JAMAL-AHMAD and J. N. CARTER

ABSTRACT

The American Society of Civil Engineers (ASCE) have built a scale model of a four story building and made available the acceleration data for the undamaged structure and for eight different configurations of damage which is used to assess techniques for damage detection, damage severity assessment, damage localization and identification of damage type. Data representing Ambient, Shaker and Hammer as input excitations are available. Previous publications that have used the experimental data have reported limited success in the detection and damage severity assessment. In this paper we describe a methodology that uses a combination of wavelet multi-resolution analysis, principal component analysis, the Welch spectrum estimation method and Adaptive filtering to track changes in natural frequencies. We have successfully detected, for all three input types, all of the damage configurations and completed a severity assessment. This is achieved without explicitly using the input measurements, a mathematical model of the structure or measurements from the damage cases.

INTRODUCTION

It is known that global damage in mechanical structures, which causes a change in the stiffness properties, can be inferred by noting a change in the natural frequencies [1]. A natural frequency is a frequency at which a system amplifies the effect of its input. In the absence of measurements of the input acting on a system, which is the usual situation in practice, it is not easy to determine the relative importance of the dominant frequencies in the frequency spectrum to determine which ones are the natural frequencies. In such circumstances it is customary to assume that the input is a random noise with a flat energy spectrum over the bandwidth of interest. We are then able to infer the natural frequencies from the frequency spectrum of the output response by isolating the dominant frequencies. This is relatively easy to do by visual inspection of the spectrum but more difficult to program a computer to carry out due to the presence of noise and disturbance which cause spurious frequency spikes, not associated with natural

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Ключевые слова:

Содержание.