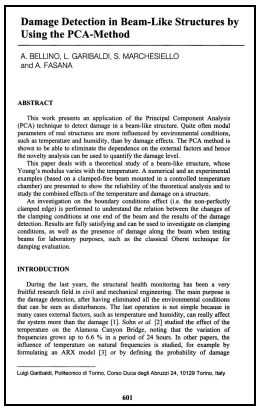

Damage Detection in Beam-Like Structures by Using the PCA-Method

A. BELLINO, L. GARIBALDI, S. MARCHESIELLO and A. FASANA

ABSTRACT

This work presents an application of the Principal Component Analysis (PCA) technique to detect damage in a beam-like structure. Quite often modal parameters of real structures are more influenced by environmental conditions, such as temperature and humidity, than by damage effects. The PCA method is shown to be able to eliminate the dependence on the external factors and hence the novelty analysis can be used to quantify the damage level.

This paper deals with a theoretical study of a beam-like structure, whose Young's modulus varies with the temperature. A numerical and an experimental examples (based on a clamped-free beam mounted in a controlled temperature chamber) are presented to show the reliability of the theoretical analysis and to study the combined effects of the temperature and damage on a structure.

An investigation on the boundary conditions effect (i.e. the non-perfectly clamped edge) is performed to understand the relation between the changes of the clamping conditions at one end of the beam and the results of the damage detection. Results are fully satisfying and can be used to investigate on clamping conditions, as well as the presence of damage along the beam when testing beams for laboratory purposes, such as the classical Oberst technique for damping evaluation.

INTRODUCTION

During the last years, the structural health monitoring has been a very fruitful research field in civil and mechanical engineering. The main purpose is the damage detection, after having eliminated all the environmental conditions that can be seen as disturbances. The last operation is not simple because in many cases external factors, such as temperature and humidity, can really affect the system more than the damage [1]. Sohn *et al.* [2] studied the effect of the temperature on the Alamosa Canyon Bridge, noting that the variation of frequencies grows up to 6.6 % in a period of 24 hours. In other papers, the influence of temperature on natural frequencies is studied, for example by formulating an ARX model [3] or by defining the probability of damage

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Ключевые слова:

Содержание.