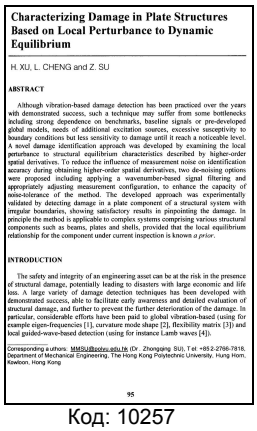

Characterizing Damage in Plate Structures Based on Local Perturbance to Dynamic Equilibrium

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ABSTRACT

Although vibration-based damage detection has been practiced over the years with demonstrated success, such a technique may suffer from some bottlenecks including strong dependence on benchmarks, baseline signals or pre-developed global models, needs of additional excitation sources, excessive susceptivity to boundary conditions but less sensitivity to damage until it reach a noticeable level. A novel damage identification approach was developed by examining the local perturbance to structural equilibrium characteristics described by higher-order spatial derivatives. To reduce the influence of measurement noise on identification accuracy during obtaining higher-order spatial derivatives, two de-noising options were proposed including applying a wavenumber-based signal filtering and appropriately adjusting measurement configuration, to enhance the capacity of noise-tolerance of the method. The developed approach was experimentally validated by detecting damage in a plate component of a structural system with irregular boundaries, showing satisfactory results in pinpointing the damage. In principle the method is applicable to complex systems comprising various structural components such as beams, plates and shells, provided that the local equilibrium relationship for the component under current inspection is known *a prior*.

INTRODUCTION

The safety and integrity of an engineering asset can be at the risk in the presence of structural damage, potentially leading to disasters with large economic and life loss. A large variety of damage detection techniques has been developed with demonstrated success, able to facilitate early awareness and detailed evaluation of structural damage, and further to prevent the further deterioration of the damage. In particular, considerable efforts have been paid to global vibration-based (using for example eigen-frequencies [1], curvature mode shape [2], flexibility matrix [3]) and local guided-wave-based detection (using for instance Lamb waves [4]).

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Power Losses in PZT Disk Actuators' Adhesive

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Piezoelectric patches are used in structural health monitoring (SHM) to generate diagnostic acoustic waves traveling in a structure and to gather the electro-mechanical impedance (EMI) signatures of structures. Piezoelectric patches are generally bonded to structures by means of adhesive layers. The adhesive layers could affect both the amplitude of the generated acoustic waves and the EMI signature of the structure. This article describes an analytical model to account for the power losses incurred by the adhesive layer used to bond a circular actuator to a structure at resonance. Validation of the model was carried out by actuating various sensors mounted with epoxy adhesive thickness ranging from 20 to 640 цт on aluminum plates. Experimental results confirmed that the thickness and the tangent loss modulus of the adhesive layer might play a significant role in the energy dissipated. In addition, this article explains how to interpret low-frequency EMI signature to assess the quality of a bond and estimate the thickness of the adhesive layer.

Ключевые слова:

Содержание.