SMART DETECTION SYSTEM BASED ON PIEZO-COMPOSITE TRANSDUCERS FOR SHM APPLICATIONS

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Abstract

Ultrasonic-based SHM (Structural Health Monitoring) applications commonly rely on the use of piezoelectric patches to emit and receive ultrasonic waves. The objective is to study the propagation of the waves through a structure to assess its structural integrity. Because of the elevated number of echoes and possible modes of propagation of the waves within the structure, those applications suffer from a burden of signal processing. This paper presents a smart detection system based on piezo-composite transducers together with specific electronics that was developed and successfully tested for reducing the complexity of the SHM detection schemes by selecting the mode and direction of the Lamb waves received. The piezo-composite is composed of a row of eight independent ceramic pillars separated with polymer, so it is a 1-D array of independent piezo-patches. Used with adequate electronics and signal processing, it was shown that it allowed selecting direction and mode of the Lamb waves. The selective techniques are based on the knowledge that the modes of the Lamb waves propagate at different speeds. As the piezo-composite emits or receives eight signals from eight positions on the structure, it is possible to distinguish waves propagating at different velocities.

Keywords SHM, NDT, piezo-patches, piezo-composite, piezoelectric transducer array, ultrasonic methods.

1. Introduction

1.1. *Problematic*

SHM requires the fusion of different engineering disciplines such as signal processing, electronics, acoustics, or mechanics. One of the most common detection techniques is to emit and receive ultrasonic waves with piezo-electric transducers attached to the structure. A simple setup to assess the propagation of the wave is to have two piezo-patches, one acting as emitter and the other acting as a receiver. The properties of the wave transmitted from the emitter to the receiver will be very likely to change in the case of a defect between the two patches. These SHM detection schemes suffer from a burden of signal processing due to different modes of propagation and the large number of interfering echoes (Debarnot *et al.*, 2006). Mode and direction selectivity of the waves is