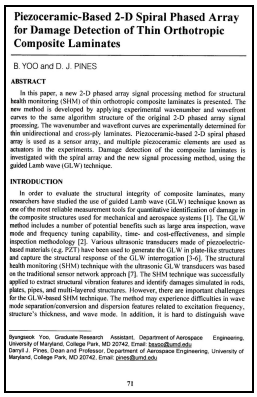

Piezoceramic-Based 2-D Spiral Phased Array for Damage Detection of Thin Orthotropic Composite Laminates

B. YOO and D. J. PINES

ABSTRACT

In this paper, a new 2-D phased array signal processing method for structural health monitoring (SHM) of thin orthotropic composite laminates is presented. The new method is developed by applying experimental wavenumber and wavefront curves to the same algorithm structure of the original 2-D phased array signal processing. The wavenumber and wavefront curves are experimentally determined for thin unidirectional and cross-ply laminates. Piezoceramic-based 2-D spiral phased array is used as a sensor array, and multiple piezoceramic elements are used as actuators in the experiments. Damage detection of the composite laminates is investigated with the spiral array and the new signal processing method, using the guided Lamb wave (GLW) technique.

INTRODUCTION

In order to evaluate the structural integrity of composite laminates, many researchers have studied the use of guided Lamb wave (GLW) technique known as one of the most reliable measurement tools for quantitative identification of damage in the composite structures used for mechanical and aerospace systems [1]. The GLW method includes a number of potential benefits such as large area inspection, wave mode and frequency tuning capability, time- and cost-effectiveness, and simple inspection methodology [2]. Various ultrasonic transducers made of piezoelectric-based materials (e.g. PZT) have been used to generate the GLW in plate-like structures and capture the structural response of the GLW interrogation [3-6]. The structural health monitoring (SHM) technique with the ultrasonic GLW transducers was based on the traditional sensor network approach [7]. The SHM technique was successfully applied to extract structural vibration features and identify damages simulated in rods, plates, pipes, and multi-layered structures. However, there are important challenges for the GLW-based SHM technique. The method may experience difficulties in wave mode separation/conversion and dispersion features related to excitation frequency, structure's thickness, and wave mode. In addition, it is hard to distinguish wave

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Ключевые слова:

Содержание.