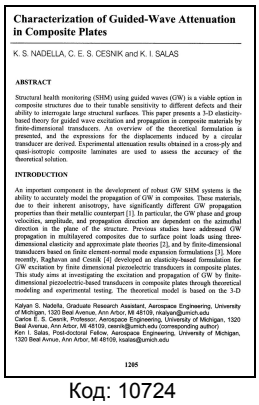

Characterization of Guided-Wave Attenuation in Composite Plates

K. S. NADELLA, C. E. S. CESNIK and K. I. SALAS

ABSTRACT

Structural health monitoring (SHM) using guided waves (GW) is a viable option in composite structures due to their tunable sensitivity to different defects and their ability to interrogate large structural surfaces. This paper presents a 3-D elasticity-based theory for guided wave excitation and propagation in composite materials by finite-dimensional transducers. An overview of the theoretical formulation is presented, and the expressions for the displacements induced by a circular transducer are derived. Experimental attenuation results obtained in a cross-ply and quasi-isotropic composite laminates are used to assess the accuracy of the theoretical solution.

INTRODUCTION

An important component in the development of robust GW SHM systems is the ability to accurately model the propagation of GW in composites. These materials, due to their inherent anisotropy, have significantly different GW propagation properties than their metallic counterpart [1]. In particular, the GW phase and group velocities, amplitude, and propagation direction are dependent on the azimuthal direction in the plane of the structure. Previous studies have addressed GW propagation in multilayered composites due to surface point loads using three-dimensional elasticity and approximate plate theories [2], and by finite-dimensional transducers based on finite element-normal mode expansion formulations [3]. More recently, Raghavan and Cesnik [4] developed an elasticity-based formulation for GW excitation by finite dimensional piezoelectric transducers in composite plates. This study aims at investigating the excitation and propagation of GW by finite-dimensional piezoelectric-based transducers in composite plates through theoretical modeling and experimental testing. The theoretical model is based on the 3-D

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