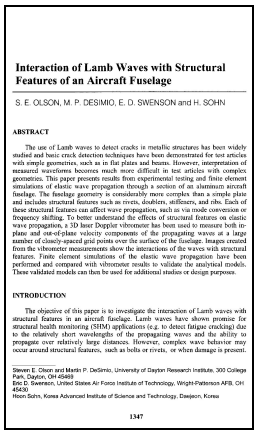

Interaction of Lamb Waves with Structural Features of an Aircraft Fuselage

S. E. OLSON, M. P. DESIMIO, E. D. SWENSON and H. SOHN

ABSTRACT

The use of Lamb waves to detect cracks in metallic structures has been widely studied and basic crack detection techniques have been demonstrated for test articles with simple geometries, such as in flat plates and beams. However, interpretation of measured waveforms becomes much more difficult in test articles with complex geometries. This paper presents results from experimental testing and finite element simulations of elastic wave propagation through a section of an aluminum aircraft fuselage. The fuselage geometry is considerably more complex than a simple plate and includes structural features such as rivets, doublers, stiffeners, and ribs. Each of these structural features can affect wave propagation, such as via mode conversion or frequency shifting. To better understand the effects of structural features on elastic wave propagation, a 3D laser Doppler vibrometer has been used to measure both in-plane and out-of-plane velocity components of the propagating waves at a large number of closely-spaced grid points over the surface of the fuselage. Images created from the vibrometer measurements show the interactions of the waves with structural features. Finite element simulations of the elastic wave propagation have been performed and compared with vibrometer results to validate the analytical models. These validated models can then be used for additional studies or design purposes.

INTRODUCTION

The objective of this paper is to investigate the interaction of Lamb waves with structural features in an aircraft fuselage. Lamb waves have shown promise for structural health monitoring (SHM) applications (e.g. to detect fatigue cracking) due to the relatively short wavelengths of the propagating waves and the ability to propagate over relatively large distances. However, complex wave behavior may occur around structural features, such as bolts or rivets, or when damage is present.

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Ключевые слова:

Содержание.