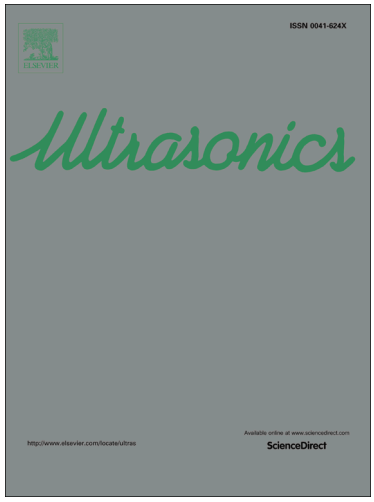

A Lamb waves based statistical approach to structural health monitoring of carbon fibre reinforced polymer composites

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A LAMB WAVES BASED STATISTICAL APPROACH TO STRUCTURAL HEALTH MONITORING OF CARBON FIBRE REINFORCED POLYMER COMPOSITES

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ABSTRACT

The research investigates a Lamb-Wave based structural health monitoring approach matching an out-of-phase actuation of a pair of piezoceramic transducers at low frequency. The target is a typical quasi-isotropic carbon fibre reinforced polymer aeronautical laminate subjected to artificial, via Teflon Patches, and natural, via suitable low velocity drop weight impact tests, delaminations. The performance and main influencing factors of such an approach are studied through a Design of Experiment statistical method, considering both Pulse Echo and Pitch Catch configurations of PZT sensors. Results show that some factors and their interactions can effectively influence the detection of a delamination-like damage.

Key words: Carbon Fibre Reinforced Polymer Composite, Ultrasonic Lamb Waves, Structural Health Monitoring, Barely Visible Impact Damage, Design of Experiments, Analysis of Variance

1. Introduction

Carbon Fibre Reinforced Polymer (CFRP) composites have been developed since the '60s [1] and allow [2] the design of resistant and innovative light weight primary structures, replacing traditional metallic materials, due to their high strength–weight and moduli-weight ratios, excellent fatigue strength as well as fatigue damage tolerance. Another advantage is their non-corroding behaviour. However, their intensive structural use remains almost limited due to, among other factors, several peculiar damage mechanisms, which are able to degrade quickly the mechanical properties and strength [2]. An interesting example,

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