CHARACTERIZATION OF CRACKS AND DELAMINATIONS USING PWAS AD LAMB WAVE BASED TIME-FREQUENCY METHODS

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Abstract- ***Use of smart sensor technology along with intelligent signal processing plays a crucial role in the implementation and working of ultrasonic wave based damage detection system. In this work, the interaction of A_0 Lamb mode with damages like crack and delamination are studied. Piezoelectric Wafer Active Sensors (PWAS) are used for generation of Lamb waves to detect damages in metal and composite structures. Experiments were conducted on aluminum plates to study the interaction of Lamb wave with crack oriented at different angles and on a titanium turbine blade of complex geometry with a fine surface crack. A geodesic based Lamb wave approach was employed to locate a crack in an aluminum plate. The existing geodesic algorithm is improved by replacing the Dijkstra's algorithm with the accurate fast marching method. Further, the interactions of A_0 mode with multiple layer delaminations in glass fiber epoxy composite laminates were studied. Spectral Finite Element Method (SFEM) is used for numerical simulation to validate the experimental results. Time-frequency analysis techniques, namely Wavelet Transform (WT) and Hilbert Huang transform (HHT) are used to study the experimental signals and their performances were compared. This study provides significant insight into the problem of identifying localized damages in the structure using integrated PWAS and dispersion of multi-frequency signal after they interact with different types of damage.***

Index terms*:* Lamb waves, PWAS, Time-frequency analysis, Composites, Geodesics, Spectral Finite element method, Wavelet transform, Hilbert-Huang transform, Delamination.