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Real-Time Characterization of Materials Degradation Using Leaky Lamb Wave

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Leaky Lamb wave (LLW) propagation in composite materials has been studied extensively since it was first observed in 1982. The wave is induced using a pitch-catch arrangement and the plate wave modes are detected by searching minima in the reflected spectra. The wave behavior in multi-orientation laminates was well documented and corroborated experimentally with a very high accuracy. The sensitivity of the wave to the elastic constants of the material and to its boundary condition led to several studies where the elastic properties were inverted and the bonding characteristics were evaluated.

Recently, the authors modified their experimental setup to allow measuring dispersion curves at a significantly higher speed than ever recorded. A set of 20 angles of incidence along a single polar angle were acquired in about 45 seconds. The reflection spectra are acquired in real time while filtering the high frequency noise allowing to obtain reliable data at ranges of amplitudes that are much lower than were used in prior studies. This method makes the LLW a practical quantitative tool for both inversion of the elastic properties and flaw characterization. The emphasis of the current study is on the detection and characterization of flaws. The composite is modeled as transversely isotropic and dissipative medium and the effect of flaws is analyzed and compared to the experimental data using the LLW setup.

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