CHARACTERIZATION OF LAYERED MATERIALS USING SELECTIVE ULTRASONIC GUIDED WAVE MODES

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Many engineering applications are dealing with composite materials and multi-layered structures of various materials. Characterization of damages in layered materials need a greater attention due to the formation of defects such as delaminations, debonds etc. at the interfaces. Ultrasonic guided waves have a wide range of applications in dealing with laminated composites and other layered materials in recent years. Being dispersive waves, the characteristics of a Lamb wave can be interpreted through a dispersion dia-gram and wave structure anaylsis. In the later, one can obtain the mode shapes and their corresponding stress and displacement profiles for a given Lamb wave mode. Interpretation of the wave structure for a given layered material would result in identifying optimum modes and their frequencies sensitive to inspect a particular layer. After a brief introduction into the fundamentals of the technique some principles with increasing complexity regarding the number of layers as well as their difference in material parameters and coupling will be explained in terms of varying geometry, material and damage parameters before relating and discussing this in the context of different practical examples of layered structures including bonded sheet metal, a patched metallic repair and layered glass. Having the input of dispersion diagrams and wave structure plots, numerical models based on COMSOL Multiphysics and the NDE simulation tool CIVA to characterize the layered materials will presented including the results obtained on the basis of experimental validation.