COMPOSITE MATERIAL CONTROL BY ULTRASOUND

Rafik HALIMI

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Abstract : As all materials used in industries, composite materials must be characterized and inspected to satisfy required quality and safety conditions. Although their anisotropic and viscoelastic properties their give a particular and complex character. As an example, the most of the elements used in the aircraft industry are thin structures of large surface that need to be controlled. The traditional non-destructive testing techniques by ultrasounds such as echography take time. This is why Lamb waves are most powerful for the control of these structures. These waves have the advantage of exploring all the thickness of plate and propagate at long distances. The work presented in this thesis studies the interaction of fundamental Lamb mode (S0) with various types of simple defects geometry. The studied materials are relatively thin plates; it concern two types of aeronautical composite structures with polymeric matrix: sandwiches with aluminium honeycomb and epoxy carbon laminate. An experimental device was developed in order to generate and to detect Lamb waves with contact using piezoelectric transducers. The comparison of a reference signal, that means a registered signal when the wave crosses a healthy zone, and a signal having undergone the modifications bound to the interaction with a defect, must show the presence in the structure, localization and the dimension estimation of the damage. Conventional echographic images C-scan and B-scan were carried out to know the position and size of defects. Finally, in order to take into account the attenuation resulting from many complex phenomena such as anisotropic viscoelasticity and the dispersion we will face in a composite material, energy velocity measurements and the attenuation for various frequencies were carried out.

Keywords : Ultrasound, Lamb waves, dispersion, C-scan images, composite materials