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Inspection of laminated composite materials by two ultrasonic techniques

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Abstract: This paper presents some ultrasonic methods to detect and to characterize defects, possibly obtained after damage caused in composite materials. Firstly, artificial defects are located by two piezoelectric transducers. A two-dimensional ultrasonic cartography C-scan, performed section by section, at different positions which took part through the thickness of acarbon fiber-reinforced plastic composite beam, to be analyzed. Next, fundamental symmetric S0 mode of Lamb waves is used to measure the size of the delamination by scanning over the surface beneath which a delamination lies. A remarkable decrease in the arrival time due to the delamination is detected, and the delamination length can be calculated based on a simple model for Lamb-wave propagation. Furthermore, the delamination edge is located as a sudden decrease in the amplitude. The rate of decrease in amplitude of an individual pulse cycle was detected to vary with the depth of the delamination, being most sensitive to delaminations near the surface of the plate. This is particularly useful when sizing for defects close to the surface, where a normal-incidence pulse-echo ultrasonic method has problems, particularly when the depth of the defect or the back-wall echoes lie within the length of the transmitted ultrasonic pulse. The technique has potential for faster c-scanning of a complete plate than the usual normal-incidence pulse-echo method.

Keywords : Ultrasonic C-scan, laminate plate, delamination, Lamb wave