Application of Pulse Compression Techniques in Air Coupled UT for Aerospace Parts Inspectio

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In the aerospace industry, there are many structures made from composite materials that cannot be inspected by contact or immersion. Air-coupled ultrasound testing (ACUT) is one of the most emerging NDE approach for application in inspection of aerospace structures when the contact or immersion is not desirable. In ACUT, the main techniques used are a) Through-transmission compressional wave, b) Through-transmission shear wave, c) Pseudo pulse-echo, d) Through-transmission Lamb Waves, e) Pitch-Catch Lamb wave. All of them suffer from a low signal-to-noise ratio (SNR) due to the enormous differences in acoustic impedances that are manifested in the system, between the transductors and the air and between the pieces and the air, to this must also be added the attenuation of the UT inside of materials used in the Aerospace industry, such as honeycomb or CFRP structures. To implement this type of applications it is necessary to have transducers that can overcome this acoustic impedance difference and ultrasonic device with cutting-edge capabilities in terms of signal sensitivity, digitalization, pulsing capabilities, and frequency range. In addition, it is necessary to establish strategies that allow improving SNR. The pulse compression approach applies a frequency-swept exciting signal into an object and the signal reflected from the target is decoded to compress the signal, therefore the signal to noise ratio (SNR) is increased and the resolution is enhanced. The complexity required in electronics to generate an exciting signal for pulse compression techniques and the implementation problems have hindered its use in the field of practical NDT applications. But they are viable now with the new generation of UT devices that include AWG capabilities. In this contribution, we present a comparative study on the benefits of applying pulse compression based in AWG to main ACUT techniques for the inspection of CFRP parts. We also discussed the effect of pulse compression on improving the Signal-to-Noise Ratio (SNR) in the main ACUT techniques.