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Comparison of different ultrasonic techniques for detection of defects in CFRP

Goal of the thesis

Ultrasonic non-destructive testing (NDT) can detect hidden flaws inside a test piece, such as voids, cracks, disbands, inclusions and other discontinuities, to measure thickness and to analyze the properties of the material.

The aim of this thesis is to compare different ultrasonic techniques for inspection in CFRP materials and evaluate the practicality of each technique. CFRP is a term used to describe a fiber-reinforced composite material that uses carbon fiber as the primary structural component.

Model of CFRP plate inspection in CIVA

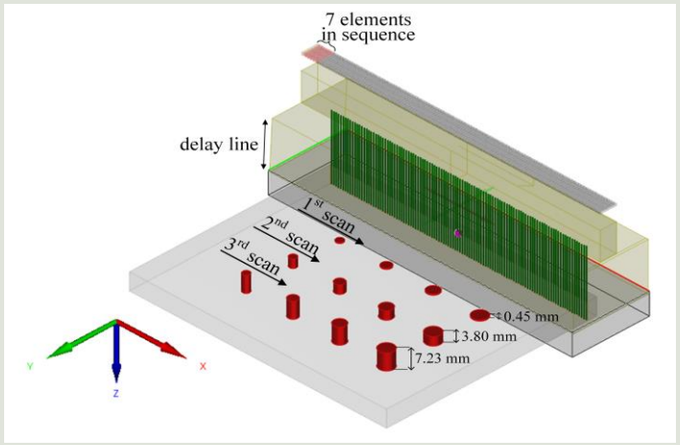

Figure 1. Example of one of the modelled configurations using phased array for the inspection

Various configurations were modelled in CIVA software in order to select the most appropriate one. The used transducers irradiated ultrasonic waves of 5 MHz.

The received signal from the defects with diameter D=5mm shows us the difference in the A-scan for flaws located in various depths in the specimen. Proper selection of focusing can affect significantly the resolution of the detected flaws.

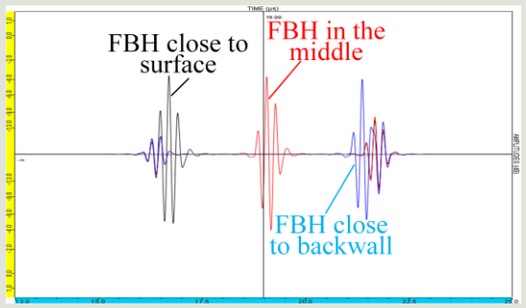

Figure 2. A-scan for flaws in different depths of D=5mm

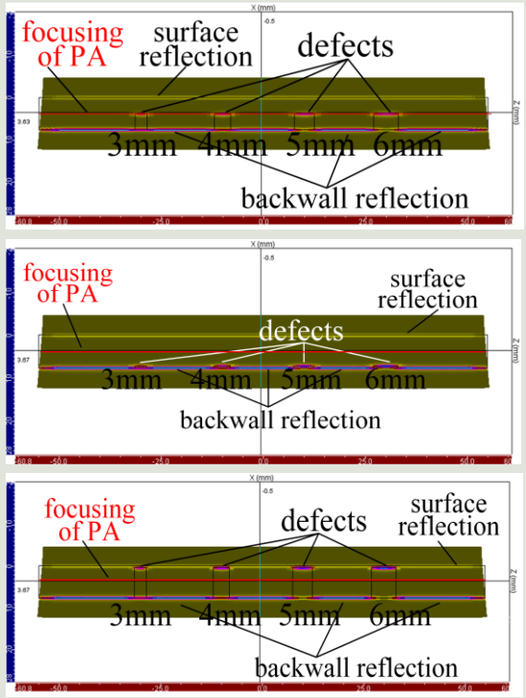

Figure 3. B-scans for inspection with single point focused phased array

In order to perform the inspection with contact transducers a special gel was placed between the sample and the probe as a coupling medium.

Experimental inspection

Figure 4. Experimental set-up for the inspection with phased array.

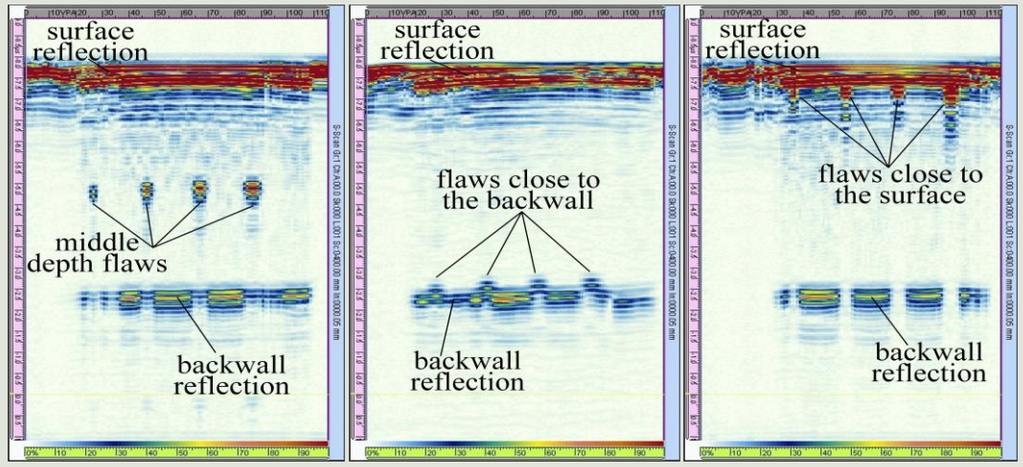

Figure 5. B-scans for the experimental inspection with single point focused phased array.

Conclusions

For the inspection of the sample phased array is more suitable, due to its ability of scanning a large area electronically, focusing and steering in a variety of ways.

The defects close to the top and bottom surface are interfering with the reflection of the surface itself. As a result, it is challenging to detect them, especially if an automatic detection method was to be established.

Defects with larger diameter return a signal with higher amplitude, which makes them easier to detect.