Time Corrected Gain Calibration for CIVA Simulated PAUT Inspection

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Background, Motivation and Objective

Time Corrected Gain (TCG) is a commonly used calibration technique for linear/sectorial scanning phased array. The process normalises amplitude responses to 80% Full Screen Height (FSH) for identical defects at varying depths by increasing system gain with time. For probe pulsing sequences incorporating multiple Virtual Probe Apertures (VPAs), a TCG will ensure that the same percentage amplitude response would be generated on each VPA for the same defect at a specified depth. TCG calibration is achieved by acquiring the gain magnitudes for each VPA to set the response amplitude to 80% FSH for 3mm Side-Drilled Holes (SDHs) at varying depths. Gain magnitudes for depths in between the measured SDH depths are acquired through interpolation. CIVA currently does not have the capacity to perform a TCG calibration on simulated data. Without performing one, a comparison with experimental data cannot be achieved. This study explores a methodology into replicating a TCG calibration on CIVA simulated data in order to appropriately compare with experimental data.

Statement of Contribution/Methods

The TCG process can be replicated in CIVA by independently simulating a designated probe setup over SDHs at depths of 20, 50, 70 and 120 mm. Figure 1A shows a simulation of a 5 MHz 60-element probe mounted on a 55^0 refraction wedge. Figure 1B shows it sequencing with 11-element apertures, sequentially stepping the first element of each aperture along the length of the probe. This generates a total of 50 VPAs: the first VPA firing elements 1-11, the second VPA firing elements 2-12, etc. From these simulations, the largest CIVA Reference Amplitude on each VPA for each SDH can be acquired. Extracting the A-scans of any CIVA test sample simulation using the same probe setup, a bespoke MATLAB script can be run to effectively calibrate the simulation using the interpolated CIVA Reference Amplitudes. Figure 1C shows the test sample being simulated: a 60mm thick block with SDHs at depths of 22.5mm and 42.5mm.

Results/Discussion

Figure 1D shows promising results of a TCG being implemented on simulated data as the average percentage amplitude responses are adjusted from 49% to 76% for the 42.5mm SDH and 76% to 79% for the 22.5mm SDH. This is due to the noticeable difference in data spread between the uncalibrated and calibrated data sets; where the TCG is levelling off the increasing trends of both uncalibrated data sets.

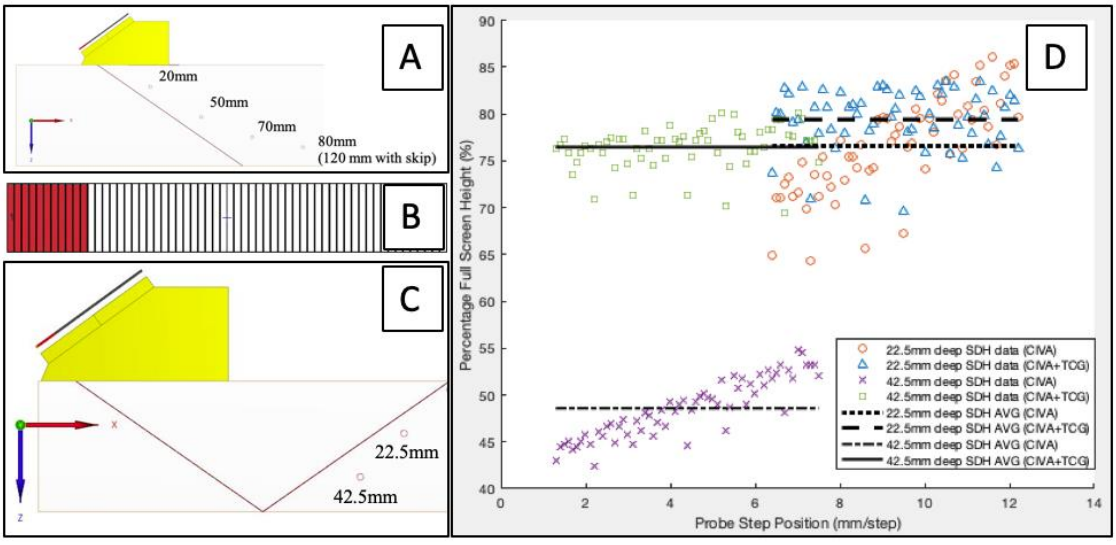

Figure 1: (A) TCG Calibration Simulation Setup, (B) 5 MHz Probe Pulsing Sequence, (C) Test Sample Simulation Setup (D) Percentage Full Screen Height Amplitude Comparison of Figure C Schematic CIVA Simulation with and without TCG Calibration