The effect of motion on ultrasound signals that are acquired using temporally long coded excitation

Frederic Cegla[1], [1]NDE Group, Imperial College London, United Kingdom

Background, Motivation and Objective

Coded excitation is a well-known method to improve signal to noise ratio (SNR) in the ultrasound acquisition process. Higher SNR results because the coded signal is temporally longer and, therefore contains more energy. The signals are pulse compressed after reception so that short signals with high SNR result. Common implementations of the technique only employ relatively short codes, due to the need to receive signals from relatively closely located reflectors. The author and his co-workers have recently presented an encoding method that can employ very long codes (>1000 pulses) for excitation. These long codes dramatically improve SNR and it was shown that a low power (<10W) electromagnetic acoustic transducer (EMAT) system could be built.

Statement of Contribution/Methods

It is unknown how these long, coded excitations perform when the transducer is moving during the acquisition process. Therefore, the effect of motion while acquiring data with long coded sequences was investigated in this work. An analytical simulation method for signals that are acquired while scanning a transducer over an object is presented. Ultrasonic time-traces from scans over objects of non-uniform thickness are simulated and the effect of the motion on SNR and measured thickness was determined. An experimental setup using a rotating Aluminum disc and an EMAT was used to experimentally validate the simulation results.

Results/Discussion

The results show good agreement between the simulations and experimental results. There is a reduction in SNR which is linearly dependent on the scan speed. For objects with linearly sloping backwalls (thickness change) with an incline of 17degrees an SNR reduction of 6dB is predicted for scan speeds of 1m/s when a code of length 2^{10} elements is employed. Random variations in thickness have a larger effect than linear thickness variations.