APPLICATION OF CROSS-CORRELATION AND WAVELET DE-NOISING TECHNIQUES FOR THE REDUCTION OF DISPERSION EFFECTS IN GUIDED ULTRASONIC SIGNALS

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ABSTRACT

Long-range ultrasonic testing (LRUT) involves transmitting a guided ultrasonic wave through a structure and receiving echoes caused by changes in acoustic impedance. There are several modes of propagation of the ultrasonic signal (wave modes) that depend on the structure and the test frequency. Some of these wave modes are dispersive: their velocity changes with frequency. Generally, LRUT procedures are designed such that non-dispersive wave modes are transmitted. However, interaction of the ultrasonic wave with the structure leads to mode conversions, some of which will be to dispersive wave modes. The effect of these dispersive wave modes is to reduce the signal to noise ratio (SNR) of the received signal. Cross-correlation and wavelet de-noising are considered here for reduction of the effect of dispersive wavemodes. An LRUT signal with dispersive and non-dispersive wave modes has been simulated and used to test these techniques. Experimental data have also been collected and used to evaluate further these techniques. Cross-correlation of the transmitted and received signals did not lead to significant improvement in SNR in either the simulated or experimental signals and led to a decrease in SNR in many of the simulated signals. Wavelet de-noising appeared to work well on some of the simulated LRUT signals, where the amplitude of the non-dispersive mode was greater than that of the dispersive mode. With the experimental data this technique improved the SNR slightly, but led to distortion of the signal. The results show that neither technique appears to be able to effectively discriminate between dispersive and non-dispersive wave modes.