

Structural noise characterization and flaw detection in austenitic stainless steels using ultrasonic signals, wavelet analysis and significance testing

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Abstract : The aim of this study is to characterize the structural noise in order to better detect flaws in several heterogeneous materials (steels, welding, composites ...) using ultrasonic waves. For this purpose, a continuous wavelet transform is applied to ultrasonic Ascan signals acquired using an ultrasonic Non Destructive Testing (NDT) device. The time-scale representation provided, which highlights the temporal evolution of the spectral content of the Ascan signals, is relevant but can lead to misinterpretation. The problem is to identify if each pattern from the wavelet representation is due to the structural noise or a flaw. To solve it, a detection technique based on statistical significance testing in the time-scale plane is used. Typical structural noise signals are then described using an autoregressive model which seems relevant according to the spectral content of the signals. The approach is tested on experimental signals, obtained by ultrasonic NDT of metallic materials (austenitic stainless steel) then of a welding in this steel and indeed enables to separate various components from the signal that is two kinds of structural noise and flaw echoes.

Keywords : NDT/NDE, ultrasons, transformée en ondelette, acier austénitique, bruit de structure