A Novel Method for Ultrasonic Imaging of Flaws in Coarse Grain Austenitic Stainless Steels

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Ultrasonic detection and imaging of flaws in thick coarse grained austenitic stainless steel components is challenging due to very high scattering. Spectral and wavelet transform based methods have been traditionally applied to reduce the noise to detect flaws. We propose a novel ensemble empirical mode decomposition based signal processing method for adaptive detection of flaws in coarse grained austenitic stainless steel.

We have analyzed ultrasonic signals obtained from stainless steel specimens of different grain size (30-200 µm) with and without flaws. The ultrasonic signals lie in two different scattering regimes with wavelength to grain size ratio of 1.8 (near stochastic scattering) to 3 (far Rayleigh scattering). The analysis gave an idea to use particular numbers of intrinsic mode functions (IMFs) in conjunction with minimization approach for the reconstruction of ultrasonic signal. We have verified the usefulness of this method by analyzing the signals obtained from 200 µm grain size specimen with artificial defects. The proposed method has been successfully employed for adaptive detection of flaws in a 50 mm thick coarse grain austenitic stainless steel specimen and for imaging of flaws.