Flaw Characterization through Nonlinear Ultrasonics and Wavelet Cross-Correlation Algorithms

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Abstract. Ultrasonic measurements have become increasingly important non-destructive techniques that characterize flaws found in various in-service industrial components. Hence, the prediction of remaining useful life based on fracture analysis depends on the accurate estimation of flaw size and orientation. However, amplitude ultrasonic measurements are not able to provide an estimate of the plastic zones that exist ahead of the crack tips. Estimating the size of the plastic zone is an advantage since some flaw may propagate faster than others. This paper presents a wavelet cross-correlation (WCC) algorithm that was applied to nonlinear analysis of ultrasonically guided waves. By using this algorithm, harmonics present in the waveforms were extracted and nonlinearity parameters were used to indicate both the tip of the cracks and size of the plastic zone. B-scans performed with the quadratic and cubic nonlinearities were sensitive to micro-damage specific to plastic zones.