Evaluation of fused features of ultrasonic and X-ray investigations to improve the accuracy of defect sizing.

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In various industrial sectors, ensuring the structural integrity of adhesive-bonded joints is of paramount importance. Ultrasonic testing has emerged as a vital nondestructive technique for evaluating the quality of such joints because of its capability to detect internal flaws and material anomalies. This study focusses on defect sizing accuracy through the use of various features extracted during the examination of adhesive-bonded single-lap joints using pulse echo ultrasonic testing and X-ray radiography. The comprehensive analysis of various features, their combinations, and their performance in different scenarios contribute to advancing the field of non-destructive testing and optimizing the assessment of adhesive-bonded joints. Multiple distinct features were extracted from ultrasonic C-scan images, including peak-to-peak amplitude, attenuation, frequency domain maximum amplitude, and absolute energy. For X-ray radiography, features such as amplitude, Harris corner detection, FAST (Features from Accelerated Segment Test), and Sobel edge detection were extracted. Subsequently, these features were combined in various configurations, producing multiple unique fused features. All the single feature images and fused ones obtained were used for further defect size estimation. The accuracy of sizing of defects utilizing features extracted from 2D radiography data outperformed their counterparts derived from ultrasonic data when examining brass inclusions. Whereas for the sizing of delamination type defects, the fused ultrasonic features demonstrated greater accuracy. This research work highlights the importance of selecting the appropriate inspection technique and explores the potential to improve defect detectability by combining images of different features, rather than relying on a single technique.