Identification of weld defect through the application of denoising method to the sound signal acquired during pulse mode laser welding

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ABSTRACT

The use of a classification model derived from the analysis of sound signals has demonstrated significant success in detecting, identifying, and characterising the weld condition, but it is affected by the filtering technique. In spite of this, denoising the transient-type signals acquired from certain types of welding remains difficult due to their unique nature. This paper describes the improvement of weld defect identification achieved by incorporating *Z*-score-based thresholding into the wavelet denoising algorithm for the pre-processing of sound signals. Separate sets of sound signals were gathered from the pulse mode laser welding process that produced good, crack, and porous welded joints. The acquired signal was filtered using the wavelet denoising technique, which involves the *Z*-score threshold. The root-mean-square and spectral entropy of both unfiltered and filtered signals were extracted, and classification models were developed using these data sets. Denoising through the *Z*-score threshold significantly reduced the dispersion trend of both RMS and spectral entropy, resulting in a much more distinct separation between the good weld, crack, and porosity classes. Model validation results also revealed that the model developed by the denoised signal based on the Z-score threshold had the highest efficiency among the other models, at 95%. This study demonstrates that the introduction of the *Z*-score threshold in wavelet denoising significantly reduced the incoherence trend of sound features, leading to a more accurate classification of weld defects. It was believed that this would pave the way for the advancement of predictive monitoring systems in laser welding applications in the future.

KEYWORDS

Classification; Laser welding; Predictive monitoring; Signal analysis; Sound signals

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