Defect detection in MAG welding using multisensor wavelet scattering features and deep autoencoders

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This paper presents an automated defect detection system for Metal Active Gas (MAG) welding, designed to improve the speed and reliability of weld inspection. Defects can significantly compromise welding quality. The proposed system uses data collected from microphones, vibration, and photodiode sensors during welding. These signals are processed using wavelet scattering transforms to extract features that capture the underlying patterns of the welding process. A deep autoencoder, trained only on data from defect-free welded joints, reconstructs input data and flags defects based on reconstruction error. Since the model has not seen defective data during training, it produces higher errors when processing flawed welded joints, allowing for effective unsupervised defect detection. The system achieved strong performance, with an accuracy of 97.28%, recall of 94.18%, F1 score of 96.32%, ROC AUC of 99.52%, and average precision of 99.33%. These results demonstrate that the method is well-suited for automated weld quality monitoring in industrial environments.