Ultrasonic weldment anomaly detection with deep neural networks in noisy conditions

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Deep neural networks based ultrasonic flaw classification systems that automatically recognize weldment defect signals are gaining popularity in non-destructive testing community. In industries, these systems are famous due to their consistent performance and alleviation of interpretation burden from human operator. However, due to limited availability of industrial ultrasonic defect signals database to train these systems, it is desirable to train these systems with lab generated ultrasonic weldment defect signals database under noise free environment and then test them on the industrial level noise. But training the deep neural network on noise free database and then testing it on noisy database will yield poor performance due to non-representative data issue. So, here, a combination of two deep neural networks is proposed where one acts as denoiser and other acts as classifier. The database generated contains weldment counterbore and defect signals without noise. These signals were then regenerated with noise to mimic industrial applicability. Classifier was then trained with noise free ultrasonic weldment defect signals while for testing, the noisy signals were first passed through the denoiser to remove noise and then fed to classifier for classification. The results demonstrate that the noise removal by denoising deep neural network enable the classifying deep neural network to achieve high accuracy even though trained with noise free ultrasonic signals.