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Adaptive Neuro-Fuzzy Inference System Model Based on the Width and Depth of the Defect in an Eddy Current Signal

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Abstract: Non-destructive evaluation (NDE) plays an important role in many industrial fields, such as detecting cracking in steam generator tubing in nuclear power plants and aircraft. This paper investigates on the effect of the depth of the defect, width of the defect, and the type of the material on the eddy current signal which is modeled by an adaptive neuro-fuzzy inference system (ANFIS). A total of 60 samples of artificial defects are located 20 mm parallel to the length of the block in each of the three types of material. A weld probe was used to inspect the block. The ANFIS model has three neurons in the input layer and one neuron in the output layer as the eddy current signal. The used design of experiments (DOE) software indicates that the model equations, which contain only linear and two-factor interaction terms, were developed to predict the percentage signal. This signal was validated through the use of the unseen data. The predicted results on the depth and width of defect significantly influenced the percentage of the signal ($p < 0.0001$) at the 95% confidence level. The ANFIS model proves that the deviation of the eddy current testing measurement was influenced by the width and depth of the defect less than the conductivity of the materials.

Keywords: non-destructive evaluation; eddy current testing; response surface methodology (RSM); neuro-fuzzy