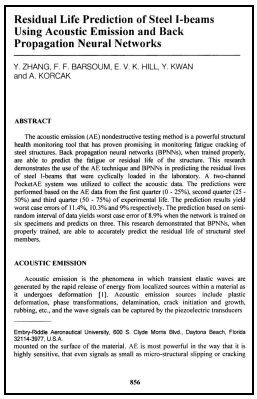

Residual Life Prediction of Steel I-beams Using Acoustic Emission and Back Propagation Neural Networks

Y. ZHANG, F. F. BARSOUM, E. V. K. HILL, Y. KWAN and A. KORCAK

ABSTRACT

The acoustic emission (AE) nondestructive testing method is a powerful structural health monitoring tool that has proven promising in monitoring fatigue cracking of steel structures. Back propagation neural networks (BPNNs), when trained properly, are able to predict the fatigue or residual life of the structure. This research demonstrates the use of the AE technique and BPNNs in predicting the residual lives of steel I-beams that were cyclically loaded in the laboratory. A two-channel PocketAE system was utilized to collect the acoustic data. The predictions were performed based on the AE data from the first quarter (0 - 25%), second quarter (25 - 50%) and third quarter (50 - 75%) of experimental life. The prediction results yield worst case errors of 11.4%, 10.3% and 9% respectively. The prediction based on semi-random interval of data yields worst case error of 8.9% when the network is trained on six specimens and predicts on three. This research demonstrated that BPNNs, when properly trained, are able to accurately predict the residual life of structural steel members.

ACOUSTIC EMISSION

Acoustic emission is the phenomena in which transient elastic waves are generated by the rapid release of energy from localized sources within a material as it undergoes deformation [1]. Acoustic emission sources include plastic deformation, phase transformations, delamination, crack initiation and growth, rubbing, etc., and the wave signals can be captured by the piezoelectric transducers

Embry-Riddle Aeronautical University, 600 S. Clyde Morris Blvd., Daytona Beach, Florida 32114-3917, U.S.A.

mounted on the surface of the material. AE is most powerful in the way that it is highly sensitive, that even signals as small as micro-structural slipping or cracking

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Y. Zhang, F.F. Barsoum, E.V.K. Hill, Y. Kwan, A. Korcak

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Ключевые слова:

Содержание.