UDC 004.89

ANALYSIS OF NEURAL NETWORKS EFFICIENCY IN ACTIVE THERMAL DEFECTOMETRY DEPENDING ON THE NUMBER OF THERMOGRAMS

Momot A. S.
National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Kyiv, Ukraine
E-mail: drewmomot@gmail.com

Active thermal nondestructive testing (ATNDT) methods are widely used in various industries due to the high speed and clarity of results. However, existing classic methods of digital thermogram processing place high demands on the parameters of thermal imaging equipment. As it known, the results of thermograms sequences processing using Fourier analysis or Dynamic Thermal Tomography are highly dependent on the number of thermograms.

These methods require hundreds of thermograms recorded at high frame rates [1]. Unlike classical methods, the use of neural networks (NN) can significantly improve the efficiency of thermograms sequence digital processing without the use of high-cost equipment [2].

A computer simulation of the multilayer CFRP plate active thermal testing process was conducted to investigate the performance of a neural network data analysis system in a different number of recorded thermograms. Four sequences containing 20, 50, 80 and 100 thermograms was obtained in the result of simulation. The duration of thermograms recording remained unchanged. Further testing of the feedforward backpropagation NN in tasks of defect detection, classification and determination of their parameters was carried out. Qualitative and quantitative results were obtained and analyzed.

Changes in the number of thermograms in the initial sequence were found to have no significant effect on NN performance in the ATNDT. Classification of temperature profiles error increases with the increase in number of thermograms and is ranged from 11.41 % to 10.23 %, the value of the Tanimoto criterion changes from 88.37 % to 89.81 %, the error in defects depth estimation falling from 9.17 % to 7.97 %. NN learning time increases for higher number of thermograms in sequence.

The obtained results made it possible to substantiate the criteria for parameters of thermal imaging equipment selection during the ATNC using intelligent data processing systems. An important task for further research is to evaluate the impact of other parameters on NN performance.

Keywords: nondestructive testing, neural networks, thermal defectometry.

References

[1] R. M. Galagan and A. S. Momot, «Analysis of application of neural networks to improve the reliability of active thermal NDT», *KPI Science News,* no. 1, pp. 7-14, 2019.

[2] R. Galagan and A. Momot, "Influence of architecture and training dataset parameters on the neural networks efficiency in thermal nondestructive testing," *Sciences of Europe*, vol. 1, no. 44, pp. 20-25, 2019.