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IMPROVING DIGITAL IMAGE PROCESSING FOR COLOR CAPILLARY FLAW DETECTION

Every year, nondestructive testing specialists have to deal with huge amounts of monotonous and cyclic work, and it is the automation of some technological stages of control that would not only speed up the control process, but also bring it to a certain unified form. Algorithms for automatic digital image processing and analysis can be used in various areas of non-destructive testing: visual measurement, capillary, magnetic particle, and digital radiographic testing. The undoubted advantage of digital processing algorithms is the ability to store the results in digital form.

Algorithms for automatic digital image processing can be implemented as a software package and used both in processing the results obtained in the field and in automated conveyor production. It should also be noted that in the future, the algorithms can be adapted to the individual characteristics of certain control objects and take into account their shape in the process of identifying indicator traces and determining their maximum length, which is normalized. The algorithms can be used to determine the quality of flaw detection materials and to compare different flaw detection kits for capillary flaw detection, which will make the comparative analysis more objective.

Thus, the aim of the research is to improve digital image processing for color capillary flaw detection.

As a result of the study, during a comparative visual analysis of the obtained images of test samples for capillary flaw detection, it was found that the optimal light sensitivity of the matrix in "warm" illumination is ISO 1600, and in cold illumination - from ISO 400 to ISO 800. It was also found that there is a large amount of noise at the ISO3200 sensitivity of the matrix.

During the experiment, an algorithm for binarizing a color digital image of a test sample for color capillary flaw detection was developed. As a result of measuring the parameters of the binarized indicator trace (local width in cross-sections, length), it was found that the results obtained deviate from the measurements made using an optical microscope by no more than 10%, which is a more acceptable indicator for capillary flaw detection.

We also developed a logical algorithm for recognizing fragments of indicator traces in a binary image with subsequent analysis for possible interconnection of neighboring fragments. A block diagram of the algorithm for determining the shape of the indicator trace and assigning it the status of "rounded" or "extended" with subsequent numerical calculation of its area and maximum length was developed.

Finally, the possible sources of errors in digital image processing were analyzed, as a result of which a summary table of the most important influencing factors was compiled and the dependence of the error value on the image resolution and the ISO sensitivity of the matrix was constructed.

As a result of the work performed, experiments were carried out to obtain digital images of control samples for capillary flaw detection. An analytical review of technical literature sources and major publications on the topic of digital image processing algorithms for indicator traces in capillary flaw detection was conducted. As a result of the analysis of the obtained digital images, the color features of indicator traces in capillary flaw detection were revealed, which led to the development of an algorithm for binary transformation of the digital image of the indicator trace. Given that a binary image can contain several indicator traces

independent of each other, an algorithm for automatic search and archiving of image fragments containing individual indicator traces was developed. The necessity of determining the shape of the indicator trace was established, which led to the development of an algorithm for determining the shape of the indicator trace, calculating its area, and determining the maximum length. The magnitude of errors that arise in the process of obtaining digital images and their subsequent digital processing is estimated.

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ВИКОРИСТАННЯ ЧАСТОТНИХ МЕТОДІВ В ІНТЕЛЕКТУАЛЬНИХ ВИМІРЮВАЛЬНИХ СИСТЕМАХ РОБОТИ ДВИГУНА ДОРОЖНЬОЇ МАШИНИ

Двигун автомобіля як джерело акустичного випромінювання характеризують значенням випромінюваної акустичної потужності, її спектром і діаграмою спрямованості випромінювання.

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