COMBINED USE OF VISUAL-OPTICAL AND EDDY CURRENT METHODS ON NON-DESTRUCTIVE TESTING IN EVALUATION OF THE DEFECTS IN STRUCTURAL ELEMENTS

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Extended truss structures are currently used as the load-carrying frame in development of orbital stations. These are unique and expensive objects with a guaranteed operating period of several decades.

In the flight mode such a structure is usually exposed to a range of dynamic and thermal factors, namely thermal cycling, shocks at docking with manned vehicles, bending moments and torques at maneouvring, collision with space particle, moving at a high velocity, pipeline corrosion, etc.

World experience of operation of various unique structures, operating under extreme conditions, assumes the availability of modern highly efficient and reliable NDT methods of quality control of welded elements during their fabrication, service and after performance of repair work [1, 2].

Reference [3] proposes going over from individual methods of inspection to integrated application of several methods of inspection of the same zone of the object. As a result, the inspection validity and recognition of the kinds of defects and accuracy of measurement of defect sizes, are improved. Combinations of different physical methods of control were selected, allowing for the specifics of space objects. A non-destructive testing system is proposed, which includes the eddy current and visual-optical methods with simultaneous computer processing of testing results, produced both by each of the methods and by the system as a whole.

Such a computer system, which combined the above methods, was implemented at the E.O.Paton Electric Welding Institute. The system incorporates a scanner, eddy current instrument, TV endoscope and personal computer (PC), which controls the fault detection system and performs processing and storage of control results. This system permits taking into account also the results of other testing methods, for instance, UT.

Fig. 1a shows a photograph, taken from a PC monitor, which shows the results of combined flaw detection in a sample with a surface crack. Shown above is a close-up of the crack, obtained with a TV endoscope, and below is the amplitude signal from eddy current flaw detector VD-12NFM.

Investigations were conducted on a flat sample of aluminium alloy. Actual dimensions of the sample (LxWxH) are 250x230x25 mm. The following artificial defects were made in the sample:

1st defect is a surface crack 25 mm long, with 0.1 mm opening width and 1 mm depth.

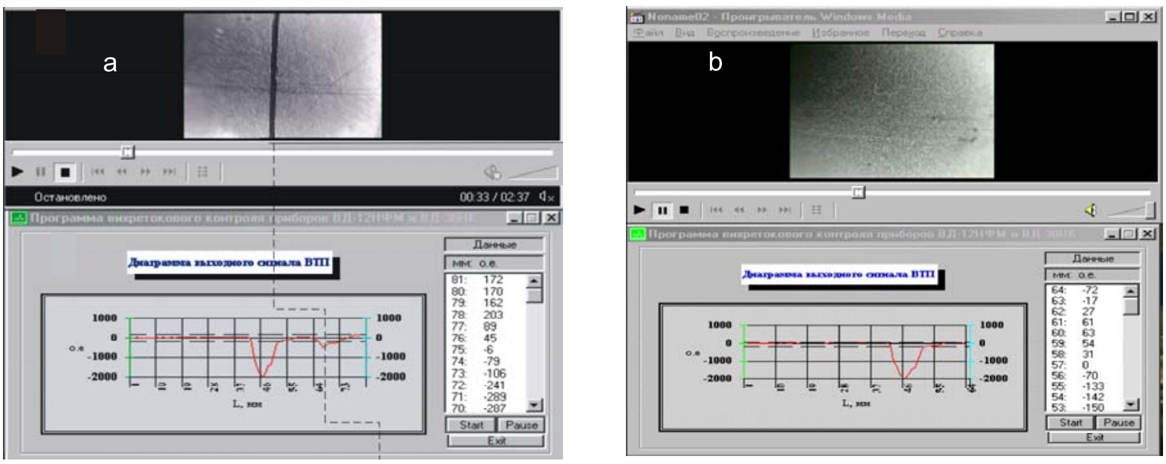
2nd defect is a surface crack 13 mm long, with 0.1 mm opening width, and 0.5 mm depth.

3rd defect is presented in the form of a subsurface crack.

Sample scanning was performed along two coordinates (x; y). Eddy current and visual sensors were attached to the carriage, which moved along the scanner guides and was driven by an electric motor. At the moment of object scanning (OS) the visual sensor signal and amplitude signal of eddy current flaw detector were simultaneously stored in the PC memory. A time matching of the recorded visual and eddy current data was provided at the moment of reproducing the signal image.

Thus, in the PC screen we simultaneously see a crack with the real opening of 100 μm (1 mm in the screen) and the signal from the eddy current flaw detector VD-12NFM.

In Fig. 1 b, we can see a “no defect” controlled surface, and at the same time also the signal of eddy current flaw detector shows the presence of a defect. In this case we have a subsurface defect. Simultaneous analysis of the visual and eddy current signal allowed revealing the type of the subsurface defect.



Conclusions: Importance of simultaneous application of several methods of control (for instance, visual-optical and eddy current method) is particularly obvious, when visual observation is difficult during inspection. It was empirically observed, that the signal from the surface defect (of small size) and the subsurface defect are similar in shape and magnitude. Therefore, when just the eddy current control is used, it is extremely difficult to analyze the obtained signal. In this case, analysis of the signals of eddy current control, complemented by visual-optical control, allows improving the validity of control and gives a better idea of the section being controlled.

References:

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