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DEVELOPMENT OF ULTRASONIC PHASSED ARRAY TECHNOLOGY FOR IDENTIFICATION WELD DEFECTS AND DETERMINATION OF THEIR GEOMETRICAL DIMENSIONS

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Abstract. One of the main parameters characterizing the technical condition of the metal constructions are the presence or absence of defects such as discontinuity in welds. Critical for decision-making, here is the information about the type of defects. The phased array technology was presented as a unique method for identification, parametrization and type of defect determination.

One of the main parameters characterizing the technical condition of the metal constructions are the presence or absence of defects such as discontinuity in welds. Critical for decision-making, here is the information about the type of defects - cracks are dangerous because of the possibility of growth, while volume defects with permissible dimensions aren't so dangerous.

At the current stage of scientific development the main task is not only the identification of objects, but also to determine their type and size, to evaluate the remaining life of these objects and evaluate the technical condition of metal. Most methods give only information about the defect presence, and not its type and size.

Therefore, the burning problem is the issue to develop a new technology that will help to get all the necessary information about the defects of welds during its diagnostics.

According to [1.2] the most convenient and affordable method for the quality control of welded joints of structures is ultrasonic inspection. High sensitivity, safety of use, and efficiency of the ultrasonic method describes it as the most competitive among.other NDT methods.

Analysis of the individual characteristics of the signals A-scan obtained from defects is rather laborious process and requires much time. Therefore there is a need for additional signal processing application. Previous studies have shown the feasibility of such an approach with the use of artificial intelligence algorithms for solving pattern recognition defects [3]. In addition, foreign literature confirm such findings. Additionally, a method that involves the separation of certain characteristics of the video signals from defects in neural networks has been implemented.

Conventional ultrasonic detection has only one display mode, image is not intuitive, and noise signal obvious, complex shape workpiece is hard to detect, to achieve a qualitative judgement

often have high demand for testing inspectors. Therefore it is necessary to develop a technology that will simplify the form and presentation of results, will provide information about the type, dimensions and location of the defects.

Due to the rapid development in the field of microelectronics, provides the use of ultrasonic phased array technology [4] provides possibly to solve a number of problems:

- Carrying out of control at the complicated (onesided) access to controlled object;
- Determine the type of defect with the possibility of foreseeing its growth;
- Determination of defects orientation and size;
- The complexity of the control;
- Information content increasing;
- Ability to save and restore test results;
- Simplification of information concerning the interpretation of the detected defect.

Years of experience of phased array technology usage in medical ultrasonic diagnosis and the development of phased array technology tools confirmed the possibility of adoption this technology in the industry. The advantage of this technology is the visualization of defects in real time (see Fig. 1).

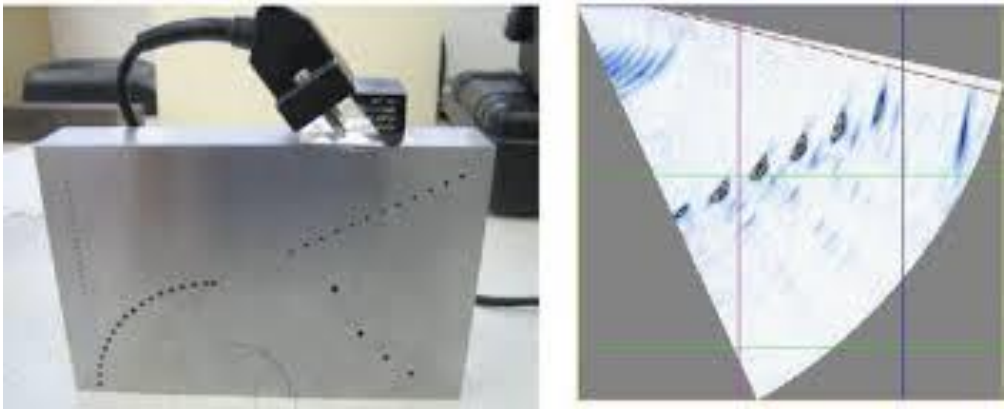

Figure 1 – Visualization of defects with the help of phased array technology

Ultrasonic phased array have high identification ability and parametrization of defects.

Phased array technology use an array of elements, all individually wired, pulsed and time-shifted (see Fig.2) [5]. The most common is a linear array containing 32 ÷ 128 elements that can be multiplexed and/or electronically controlled and directed via an electronic control unit. The basic parameters of the phased array is frequency, the width of the element, the distance between the centers of the elements, the number of elements, the aperture. Changing the combination of these parameters allows to use the technology for the weld of various thickness, shape and material of manufacture.

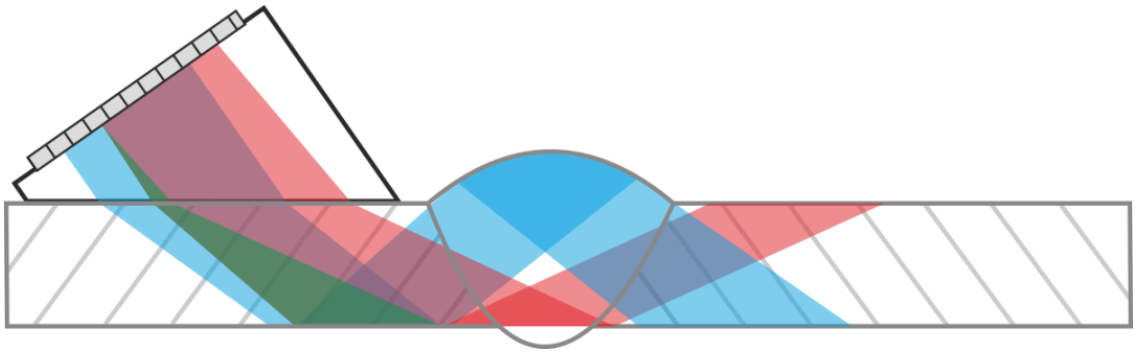

Figure 2 – Weld testing with the help of phased array technology

Application of phased array technology with dense ultrasonic beam radiation enables high accuracy for anomalies and defects of welded joints identification.

As a result of testing with phased array technology set of acoustic images is received. Therefore special signal processing of information for futher parametrization of defects is needed.

There are many complex software, that process of the process acoustic imaging [6], but the cost of it is very high, so there is a need to develop own modules of information processing that will implement the following steps (Fig. 3):

1) the study of information about the size, material, and access to controlled object to select transducer with phased array parameters;

2) the accumulation and preservation of acoustic images with parallel information storage about transducer with phased array mechanical displacement;

3) the import and processing of acoustic images for reconstruction model of controlled object

4) analysis of the inspection results, conclusions prepairing about the presence and severity of defects found.

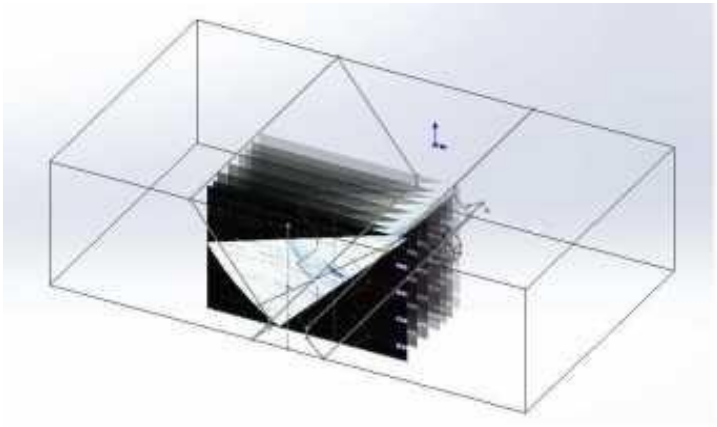

Figure 3 – Scan and reconstruction of acoustic images mode

With the help of new generating and receiving method of ultrasonic signal, in a short period of time sufficient information about the controlled object and the presence of defects in it can be obtained. Application of phased array technology will help to develop a unique method of identification of defects during nondestructive testing of materials and products.

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