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APPLICATION OF DIGITAL RADIOGRAPHY SYSTEMS FOR OBJECT INSPECTION

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The term "digital radiography" refers to a set of methods of nondestructive testing and diagnostics, in which the radiation image of the inspected object is converted at a certain stage in a digital signal. Next, this digital signal is stored in the computer's memory and there it is redistributed in the two-dimensional array of measured data that can be subjected to various types of digital processing (contrast calibration, preparation, smoothing, etc.) and finally, it is displayed on a graphic display screen or a TV-monitor as a grayscale image perceived directly by the operator [1].

Digital radiography is widely used in the leading technologically developed countries due to its obvious advantages over conventional X-ray film radiography, as the constant improvement of the technical parameters of the recording equipment provides information in real time sensitivity without conceding recording on a film. Publications on this topic are focused on the analysis of the characteristics of the used assemblies, sensitivity, performance and resolution [2,3].

The main efforts of scientists and manufacturers are aimed at creating high-performance sources and detectors of ionizing radiation, and computer processing of the results to improve the information content of the control, detection of unauthorized inclusions, finding their location, challenging the dangers of the controlled object [4].

On the basis of two 9 MeV betatron inspection systems an image of the internal contents of the car can be made (Fig. 1)/

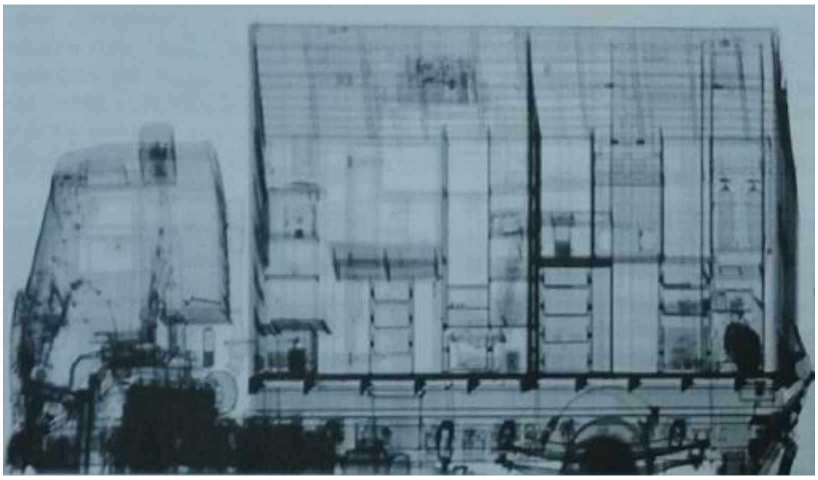

Fig. 1. The internal contents of the car body [4]

200 kV and 300 kV devices are used to control cars. Fig. 2 shows the image of the car.

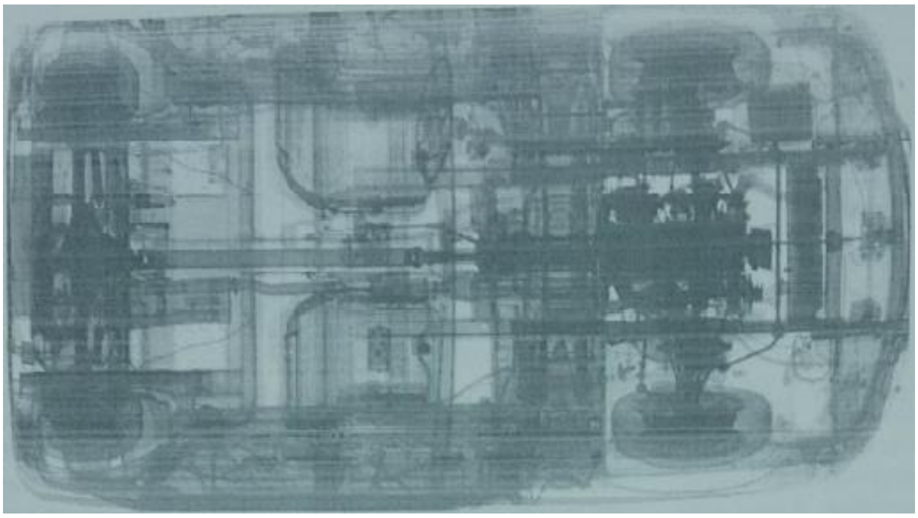

Fig. 2. Radiographs of a car, a bottom view [4].

To record the ionizing radiation passing through the controlled object three main types of detectors can be used:

- Fluorescent screens together with a CCD camera;
- Fluorescent screens together with a photodiode array;
- Scintillating crystals in complex with a photodiode array.

A specialized recovery program of the visual internal structure of the controlled product "Diada" was developed in the Institute of Non-Destructive Testing, TPU. It allows increase in the information content of the recorded data, as well as calculation of the coordinates and dimensions of local inhomogeneities or unauthorized inclusions.

Figures 3 and 4 show the control results obtained using digital radiography systems, based on the line of detectors consisting of scintillators

CsJ (T1) and photodiodes.

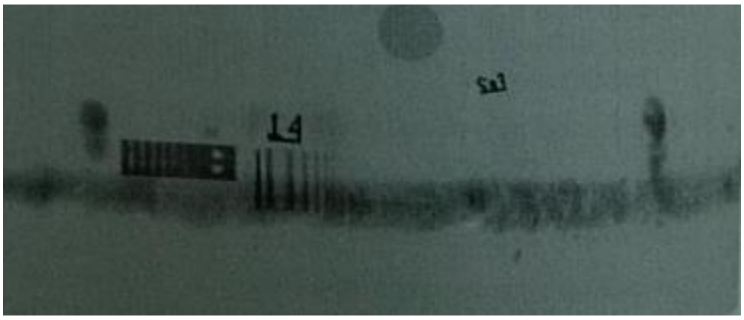

Fig. 3. Radiograph of a weld pipe diameter of 1020 mm. [4]

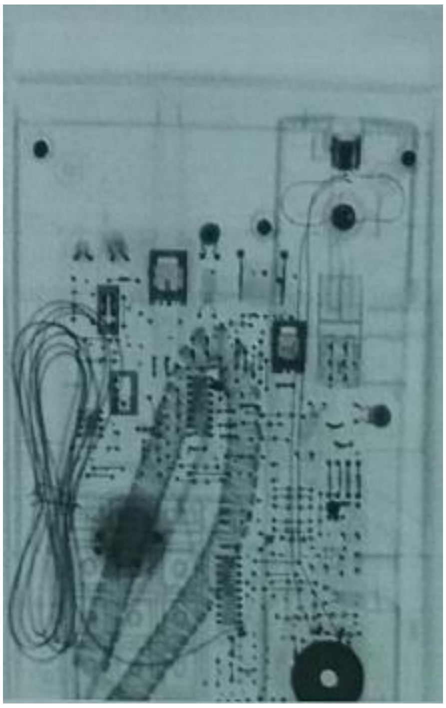

Fig. 4. The printed circuit board with an illegal radio electronic element [4].

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DIFFERENT APPROACHES FOR ULTRASONIC TIME-OF-FLIGHT TO MEASURE DISTANCE

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There are various techniques to measure the distance using ultrasonic testing. Ultrasonic testing method is based on the capture and quantification of either the reflected waves or the transmitted waves and is also based on the vibration in materials which is usually mentioned as acoustics. The ultrasonic time-of-flight (TOF) to measure the distance includes different techniques like pulse echo method [1], threshold detection, cross-correlation estimator [3] etc. The measuring distance products can contain infrared light emitters and receivers. The ultrasonic testing is based on the reflection of sound waves which are travelling in a medium.

The measuring device mainly consists of the transmitter unit and the receiver unit. The sound waves travelling from the transmitter unit is received in the receiver unit as reflected waves which are called as echo signal. To measure the distance the time taken for the sound waves to travel the distance from the source to the subject and back to the source and speed of sound in the medium is required. The ultrasonic measuring devices are used in industrial applications to measure the distance in different mediums.

The pulse echo method or the TOF method [1]consists of a transmitter unit containing a switch which helps allowing the sine wave from the function generator to the gain amplifier. The transmitter excitation is controlled digitally which is given from the function generator through the switch. The microcontroller is used for switching signal, and to calculate the distance. The receiver unit contains the amplifier which is required when higher frequency pulse is received and the comparator which compares the output signal with reference threshold level to clear out the noises and false triggering. Then it passes through the voltage limiter to which sends to microcontroller to count pulses. The transmitter passes the pulses which are received at the receiver as echo pulses. The time-of-flight (TOF) is calculated by microcontroller using the time delay between the received pulses and the transmitted edges. The Fig.1.shows the echo signal reflected at the receiver.