SIMULATOR FOR EDUCATION OF EDDY CURRENT TESTING SPECIALISTS

Peter N. SHKATOV [1], Denis V. BYDANOV [2], Sergey V. KLUEV [3]
Moscow state university of instrument making and informatics, Russia
E-mail: petr_shkatov@mail.ru, dvbydanov@mail.ru

Training of experts of eddy-current testing should be spent in laboratories specially equipped for it. Laboratories, except for park of devices with various probes should have big number of samples with natural defects. Such samples are unique, frequently have significant dimensions. Cost of the equipment demanded by existing rules of preparation of experts, is rather great, and it should reflect specificity of objects of that branch on which the expert is prepared.

From above written follows that to have in the presence all models of devices demanded for training, probes, and also versions of samples of defects for any laboratory it is rather complex. Therefore there is a problem consisting in training the expert in work with the device certain probe or test bar (or with their any combination) which at the moment of training are absent in laboratory. For the decision of the given problem the hardware-software complex is developed for a personal computer (simulator) which allows to simulate work with various models of devices, probes and test bars.

The complex allows to spend training of experts to work with the equipment (the device, probe) which at the moment of training is absent in laboratory, and also to project virtual devices and to model samples of defects. By means of the given hardware-software complex probably carrying out of certification of experts of eddy-current testing.

Also the complex allows to project virtually devices from making blocks, setting opportunities and parameters of the device It gives additional opportunities on designing eddy-current nondestructive testing devices.

The simulator represents a complex of hardware and software. Hardware are a scanner, the simulator of eddy-current probe, the simulator of eddy-current defectoscope which connect to a personal computer on which the program part of a complex is established, via interfaces USB and RS-232. Software are the modular program system using as storehouse of the information a relational database. The block diagram of a simulator is presented in a Fig. 1.
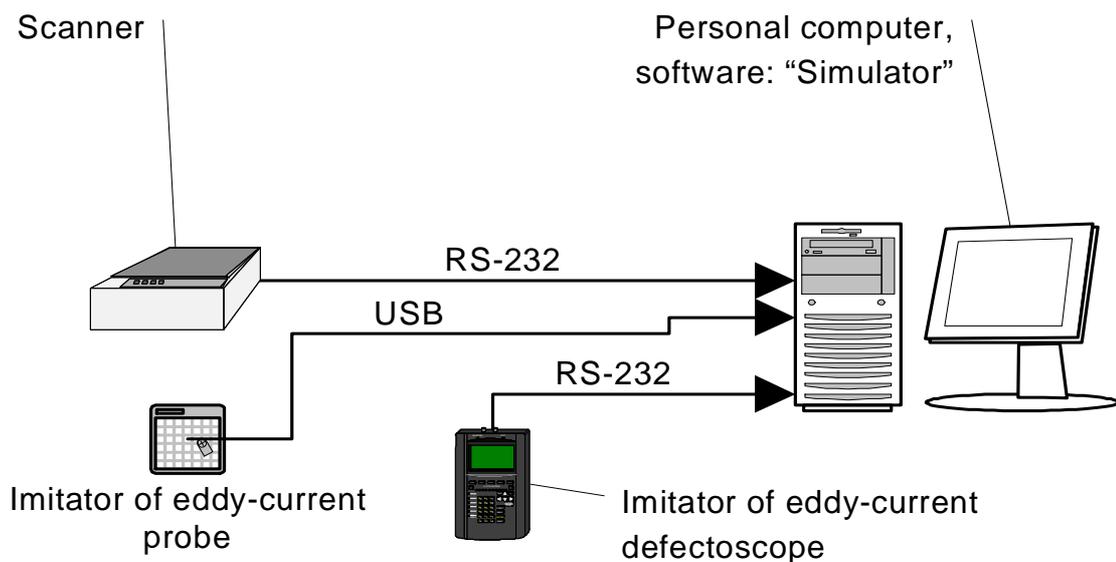

Fig. 1. The Block diagram of a simulator.

The Scanner is intended for getting of signals from the real sample of defect from their subsequent preservation in a database of a simulator. The device incorporates to a personal computer via two serial ports (interface RS-232).

The simulator of eddy-current probe represents the device developed on the basis of a tablet with a feather, and intended for imitation works with eddy-current probe. The given device incorporates to a personal computer via USB interface.

The simulator of eddy-current defectoscope represents the device developed on the basis of real eddy-current defectoscope. Incorporates to a personal computer via RS-232 interface.

The scanner is intended for cords-by-coords scanning of signals from samples of defects from their subsequent preservation in a database of a simulator. Structurally the device consists of three basic components: the device developed on the basis of plotter and eddy-current defectoscope with eddy-current probe.

The plotter model DXY-1350A of company Roland is used. On a table-top of plotter the sample of defect is fixed. Instead of a feather on plotter it is fixed probe. Operated by special software plotter carries out moving the probe to the set coordinates of the sample of defect.

The eddy-current defectoscope "ZOND VD-96", intended for revealing cracks, corrosion, discontinuity flaws and heterogeneities in a superficial layer black and nonferrous metals is used.

It is possible to carry high sensitivity to the basic features of the given device to undersurface cracks (depth – up to 5mm), revealing of defects under a layer of any dielectric covering and-or a rust, an opportunity of use of various types probes, offset in a wide range from influence of stirring factors.

Plotter and eddy-current defectoscope are connected to a personal computer via serial ports (interface RS-232). Management of plotter and defectoscope carries out module "Scanner" of a program complex "Simulator".

Two modes of scanning are supported: manual and automatic. At manual scanning the operator sets coordinates of a point on the sample of defect, plotter moves probe to a point with the set coordinates, signals from the probe act in device and further in a computer, then there is a preservation of result in a database of a simulator. In an automatic mode the operator sets a range of coordinates and step-type behaviour of scanning. The system makes scanning the sample in the set range of coordinates with the set step-type behaviour and keeps results in a database of a simulator.

The described system for scanning allows to get signals from various samples of defects, using various probes compatible with defectoscope "ZOND VD-96". Using various probes, and also changing adjustments of the device, it is possible to receive various files of signals for subsequent use. I.e. using one sample of the defect, one probe, differently adjusting defectoscope, it is possible to receive a file of signals which each cut will correspond to the certain adjustments of the device.

In aggregate with program module "Scanner" it gives the convenient tool for creation of a database of the signals got from real samples of defects and corresponding various probes with various adjustments of eddy-current defectoscope.

The simulator of eddy-current probe is intended for imitation works with eddy-current probe. The simulator represents a tablet with a feather. The given device allows to simulate work with probe. For the user of a simulator the feather is the converter, and a tablet the sample of defect.

The user moves a feather on a tablet similarly to moving вихретокового the converter on the sample of defect. It allows to learn the user to work with eddy-current probe, not having itself probe available.

The tablet is connected to a personal computer via USB interface. Program processing of signals from a tablet is carried out in the module "Modelling of process of the control" a program complex "Simulator".

The program part of a simulator represents modular program system for a personal computer for work under control of the operational system Windows, using as storehouse of the information a relational database.

The program has modular structure that allows to expand without effort its opportunities by connection of new modules. The information is stored in a relational database that gives easy access to it and fast search of necessary data. The program complex consists of 4 components: the base module (a kernel of system), applied modules of system, database system and references. The block diagram of a program complex is represented on fig. 2.

Kernel

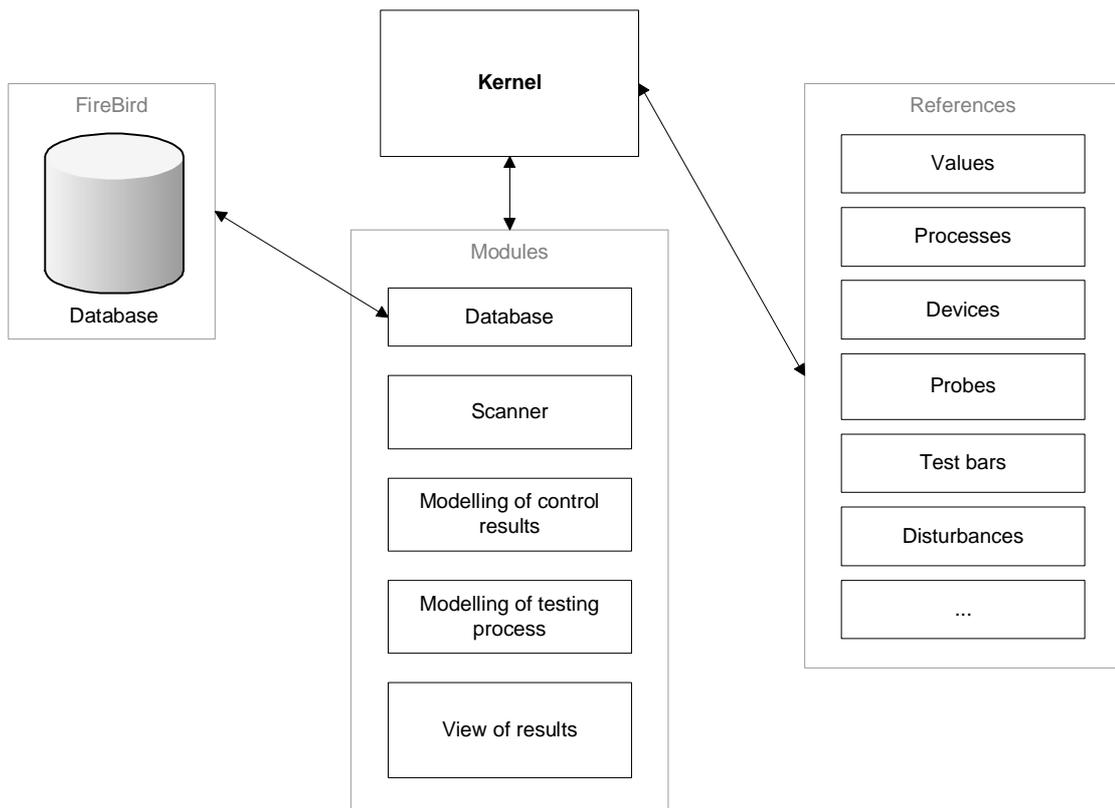| FireBird	Modules	References
Database	Database	Values
	Scanner	Processes
	Modelling of control results	Devices
	Modelling of testing process	Probes
	View of results	Test bars
		Disturbances
		...

Fig. 2. The Block diagram of a program complex "Simulator".

Modes of a simulator share depending on a direction of the dataflow on:
- Data input (by means of the scanner or using modelling of results of the control);
- Data processing (by means of modelling process of the control);
- Viewing of data (by means of a plotter of reports, schedules of diagrams).

In turn modelling of process of the control can occurs in two modes:
- In the given mode work occurs to the virtual device, virtual probe, virtual object of the control. The user sets a kind and parameters of the device, parameters of probe, parameters of object of the control (parameters of defects), presence, a kind and parameters of noise, and also volume of calculations. Under the set information the complex models the device, probe, their interaction, i.e. process of the control, counts results and represents them in the set kind. In the given mode all components of

process of the control, such as the device, probe, test bar are virtual. The mode allows to project virtually devices from making blocks, setting opportunities and parameters of the device. It gives additional opportunities on designing devices eddy-current nondestructive testing. The scheme of a mode is resulted in figure 3.

- Modelling of process of the control over use before removed from the certain sample of defect of the information. In the given mode the signals which have been removed certain probe with certain test bar are used earlier written down and kept in a database of a complex. The user defines parameters of the device (frequency, a phase, strengthening, etc.), parameters and presence of noise. In the given mode the program displays object of the control on which the user moves probe (the index of the mouse). The signal is displayed, for example, on a complex plane. The given mode is characteristic that at work the signals which have been removed from real objects of the control are used. The scheme of a mode is resulted in figure 4.
- Operating mode with the real sample of defect. In the given mode the user works with the real sample of defect. The signals received at scanning, are processed by a complex and then displayed in the set kind. In the given mode probably introduction virtual handicapes, a backlash, etc.
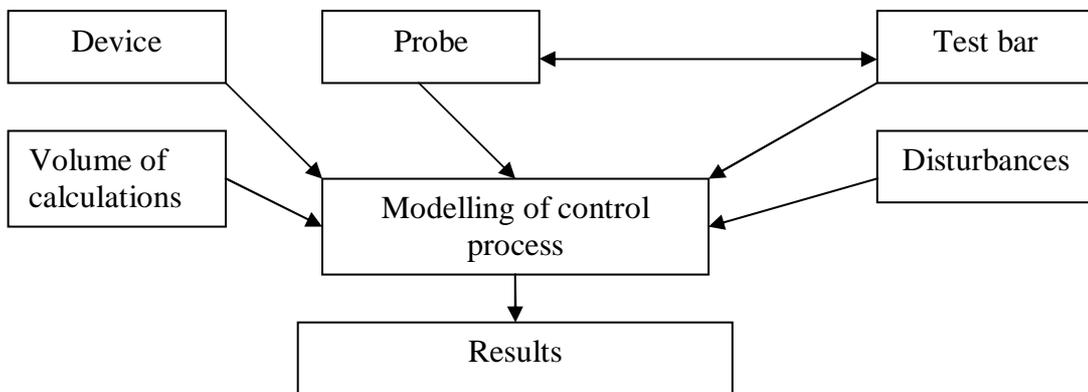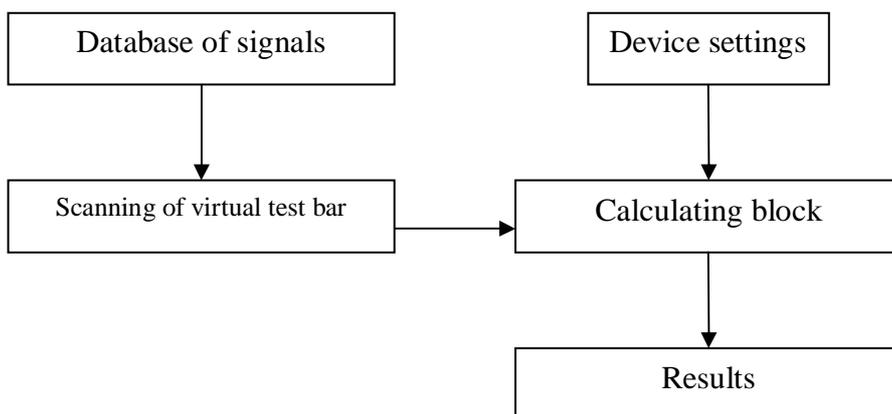

Fig. 3. Mode 1.

Fig. 4. Mode 2.

The described simulator allows to train and certificate experts of eddy-current testing over the laboratories which are not having in stock devices necessary for training, probes and objects of the control. The simulator can be used as for training and certification of experts eddy-current testing, and over designing devices nondestructive eddy-current testing.