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New possibilities of eddy-current flaw detectors

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Abstract

The paper describes a highly sensitive eddy current flaw detector that uses a pocket PC and satisfies the modern demands of NDT means. One of the demands is a binding reporting of NDT results.

1. VD-90NP eddy current flaw detector

The latest development in eddy current defectoscopy is the VD-90NP eddy current flaw detector (Fig. 1). It features the highest sensitivity and is capable of detecting defects of 0.1 mm and less depth in ferromagnetic and non-magnetic materials. The distinguishing feature of the device is the operating frequency range 10Hz-2MHz that allows everyone to solve almost all tasks of eddy current defectoscopy. Moreover, the device can be powered by both a battery and mains and it can have a boost battery to prolong the time of free running.

Fig. 1. **VD-90NP eddy current flaw detector. General view**

Fig.2. **Application example of the VD-90NP**

The instrument design employs the PLED high contrast display with the wide viewing angle that features high information display speed at subzero temperatures.

The instrument design allows the operator to hold the device on his wrist or on his waist belt (figure 2). Taking into account a low weight of the device, it significantly makes the operation simpler.

The weight and dimensions of the VD-90NP has no analogs among ones with close characteristics. The wide temperature operation range lets us use it in field conditions even during a winter period. Moreover, a high robustness against dust and moisture provides safety in severe operational conditions.

To connect to a peripheral unit, the VD-90NP is provided with a wireless communication unit via Bluetooth 2.0 that allows data transfer and device control at the distance up to 20 m. The device can be provided with a pocket PC with a specialized software.

Basic specifications

Scanning speed	- 0,02...0,1 m/s
Frequency range	- 10Hz — 2MHz
Rotation	- 0-359°
Rotation step	- 0.1°
Operating temperature	-30°C…+40°C
Level sealing protection	- IP54
Distance of radio transfer	- 20 m
Power supply – 4 x 2.7AHr NiMh AA batteries;	
Consumption current, max	
• passive radio channel	- 0.7 W
• active radio channel	- 0.9 W
Set time for operation mode, max	- 1 min
Running time, not less	
• passive radio channel	- 20 hours
• active radio channel	- 15 hours
Electronic unit weight (with batteries), max	- 0,38 kg
Dimensions, mm:	
• Electronic unit (LxWxD)	140x72x40

Differential eddy current probes (see Fig. 3) are used to transducer non-electric parameters (local discontinuities) into electrical signal by exciting eddy current in the object under a test. Then signal amplification follows where the amplitude and phase are determined by the acting induced field. To link the units we use a common cable with enhanced noise immunity. Due to that, the device turns out to be compact and has low weight. The probes are wearproof, the contact point being protected by a strong corundum cap.

Tables 1 and 2 show sensitivity threshold and maximum allowed insulant thickness for the VD-90NP flaw detector.

Table 1

Material	Sensitivity threshold, mm		
ferromagnetic	Surface roughness, max	R_a 1,25	R_z 320
	Depth	0,1	1.0
	Width	0,05	0,1
nonmagnetic	Surface roughness, max	R_a 1,25	R_z 160
	Depth	0,1	0,5
	Width	0,05	0,1

Table 2

Maximum thickness of insulant, mm	
Specimen material	
ferromagnetic	nonmagnetic
10	3

The flaw detector's generator ranges widely the excitation current frequency from 10Hz up to 2MHz, the excitation circuit current ranging 5-200 mA, that allows the use of the full range of both pencil and hole probes. The flaw detector automatically defines the probe type and sets the necessary excitation current and frequency that significantly simplifies the compensation.

Fig. 3. **VD-90NP probes package**

2. Use of pocket PC

The use of a pocket PC considerably increase the device functionality, an operator has the widest possibilities to store, process and represent the data including setting of test parameters on the pocket PC display, setting of marks on a signal graph, direct printing of reports via Bluetooth. The use of a radio channel for a data transfer allows us not to use the cables providing high mobility and easy integration into automated test workbenches.

The software helps to use the pocket PC display instead of the device display that also broadens test possibilities.

Modern requirements set for NDT means demand binding test reporting. However, the use of a personal computer and a printer is quite problematic in field and workshop conditions. An optimal way out is the employment of a pocket PC that uses a wireless radio channel for a device-to-printer data transfer. Having a low weight and small dimensions, the pocket PC provides an operator with the widest possibilities to store, process and represent the data. The bright and high contrast graphical display with the resolution 640x480 pixels deserves special attention.

The use of a built-in GPS navigator affixes a defectogram to a test site that is important when a long oil-and-gas pipeline is tested.

Fig. 4 shows the pocket PC display in test parameter set (a) and defect detection (b) modes.

3. Digital filtration methods to enhance resolution ratio

At present, the wide use of microprocessor means of data reception, its process and transfer enables an employment of digital filtration methods [1, 4]. The relevant ones are folding method and digital filtration by a window function. The results received by the use of these methods make us conclude about considerable enhancement of the signal-to-noise ratio as well as of results reliability.

To eliminate a random noise from the received signal, the VD-90NP uses methods of digital filtration that provides high accuracy and noise robustness for the equipment. When using digital filtration it is important to select correctly a window function [2, 3], that is widely used for spectrographic analysis of signals. The processing by windows is used to control the effects caused by side lobes in a signal spectrum. The wisest way is to make up an optimal window function to solve a specified task rather than to choose from the list of acquainted ones. Fig. 5 shows the use results obtained with a window function.

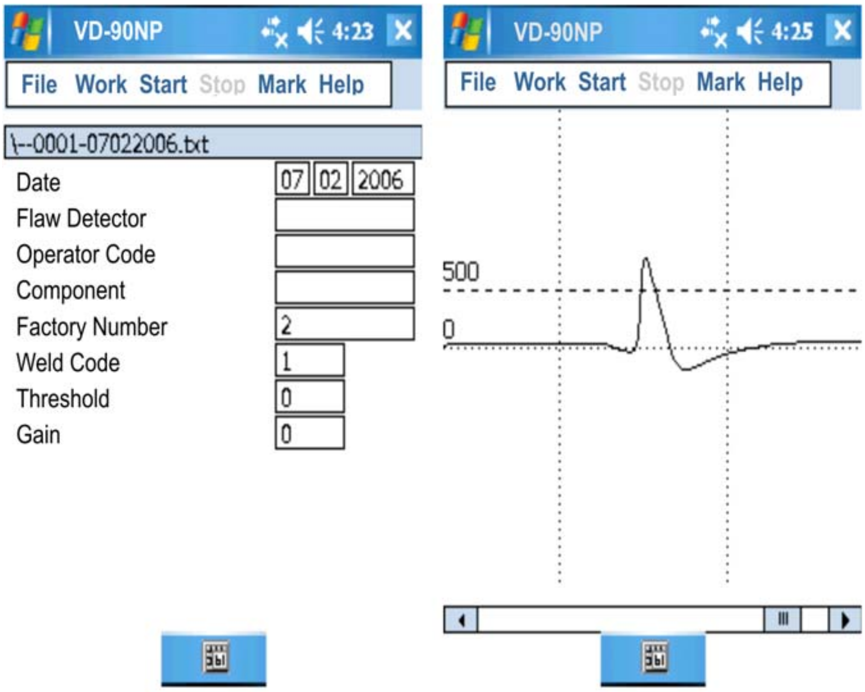

Fig. 4 **a) Test parameters set mode** **b) Defect location mode**

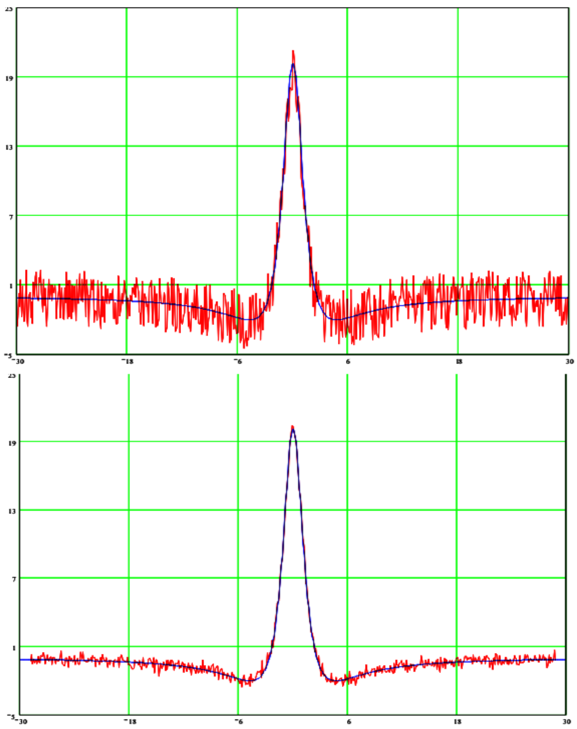

Fig. 5. **Signal digitally filtered by a window function.**

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Naujos sūkurinių srovių keitiklių signalo galimybės

Reziumė

Aprašomas labai jautrus sūkurinių srovių keitiklių signalas, kuris naudojamas kišeniniuose kompiuteriuose ir atitinka šiuolaikinių neardomųjų bandymų reikalavimus. Vienas iš reikalavimų yra privaloma neardomųjų bandymų rezultatų atskaitomybė.

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