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SIZE CONTROL PRODUCTS USING SPECTRUM OF NATURAL VIBRATIONS AND NEURAL NETWORKS

Quality control is to verify compliance with quality indicators to established requirements.

Treasure, the absence of unacceptable defects, compliance with the physical and mechanical properties and structure of the base material and coverage; accordance of geometrical sizes and cleanness of surface treatment to the necessary norms and others widespread use of non-destructive methods of control, samples that do not require cutting or destruction of finished products, allows to avoid large losses of time and material costs, to provide partial or full automation of control operations, while significantly improving the quality and reliability.

Today, none of the technological process of responsible products is not embedded in the industry without a corresponding system of non-destructive testing. Relevance is directly related to the integrated control of the parameters of the surfaces of machine parts, design and implementation of advanced non-destructive testing method and the possibility of establishing a control system.

The aim of the work is to develop an advanced non-destructive method of control through the use of amplitude-frequency characteristics which can provide the necessary quality of the surfaces of machine parts. Scientific novelty: new principles of upgrading of surfaces of machines details are offered 1. A new method for controlling the rotation of bodies is developed. It is a non-destructive method of control using the amplitude-frequency characteristics of the parts.

Integrated control system using several methods can be based on the 100 th of the total control of production by each method or based on sampling one or the other (if all) the method of control. Sometimes, additional control is carried out only in areas where the main method does not provide the specified requirements, or is intended to enhance the information content.

Control of forgings, if billets do not have allowance for "dead" zone of ultrasonic flaw detector, also uses a combination of acoustic and surface flaw detection methods.

In particularly important cases to improve the reliability of defect detection for various types, weld examination is conducted by the methods of the radiation x-raying and acoustic. Control of founding, as a rule, is executed by the method of the radiation x-raying, and an acoustic method is used to determine the location of the detected defects. Control of fungal screws provides a combination of acoustic methods to surface techniques such as capillary, magnetic and eddy-current.

Eddy current techniques and periscope review (visual-optical inspection method) or periscope review and acoustic control are used to control the internal surfaces.

The literature review presented in the first section of the work specifies the needs to improve the non-destructive method of control using gain-frequency characteristic. The formed problem influences on the quality of machine-building products and that is why requires a management. The necessity of finding solutions is also relevant because the control methods used today are resource-demanding, especially energy-intensive and time consuming.

Due to the fact that in a market economy, one of the conditions for maintaining the competitiveness of products is the use of resource-saving production processes, one of the promising directions is the application of non-destructive method of control based on the gain-frequency characteristic and creation of a new control system of simultaneously various detail parameters (quantitative and qualitative).

The experimental setting, созданный together with a student Kostina A., is developed (fig. 1) which folds: laptop 1, experimental purveyance 2, pies element 3, metallic sticks 4. Using the software on the laptop we made the sound record of the detail, by means of the program

"All Sound Editor" we corrected the sound file (allocated a specific area of sound – a sound impulse and turned into a new audio file format); by means of the program "Spektra PLUS 5.0" we converted the sound amplitude into a numerical form 4.

Fig. 1. The general view of the experimental setting

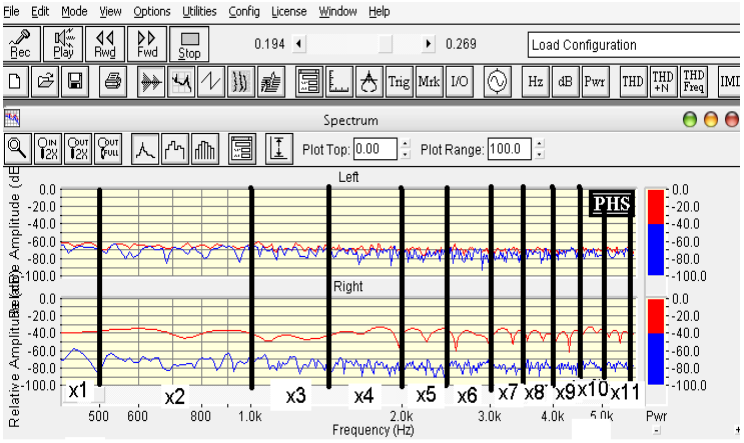

Fig. 2. Treatment of voice file and division on frequency segments

A large amount of data was received after the survey, and for its classification and further processing was introduced the concept of integral index for this purpose the whole range of frequencies (0-5500 Hertz) was divided on 11 frequency intervals in every 500 Hertz. Certain frequency filter is responsible for each frequency interval (fig. 2).

For the experiment were used samples with a diameter of 45 mm and a width of 10 mm from the material of steel 45.

Our experimental studies are based on the assumption that the increase in quality control by comparing the gain-frequency characteristics of the standard parts to the gain-frequency characteristics of batch parts.

The mean values of experimental data were used as an output for the construction of a mathematical model.

According to the results of the experiment with the software NeuroPro 0.25 was constructed a mathematical model based on neural network modeling, where the input symptoms were integral factors of frequency filters (x1, x2, x3, x4, x5, x6, x7, x8, x9, x10, x11)and the final syndromes were the value of diameters, widths of parts.

A single-layer network was built with an initial number of neurons 11, which declined after simplifying the network.

Table 1

The output is given for the checking of diameter system

X4	105,6184	250
X5	80,04061	88
x4	0,078144	2,282443
x5	-0,24128	-0,1129
A1_1	0,131428	1,189305
A1_2	-0,86966	-0,74128
A1_3	0,066853	0,793615
A1_4	-0,50195	-0,37358
Syndrome 1_1	0,5679	0,922439
Syndrome1_2	-0,89687	-0,88113
Syndrome1_3	0,400671	0,888095
Syndrome1_4	-0,83387	-0,78884
A2_1	-0,00087	-0,0819
A2_2	0,896871	0,881134
Syndrome2_1	-0,00866	-0,45024
Syndrome2_2	0,899686	0,898077
A3_1	-0,42802	0,014222
A3_2	0,613652	1,055238
Syndrome3_1	-0,81061	0,124514
Syndrome3_2	0,859876	0,913438
d	0,059683	-0,64568
D	48,05968	47,35432

x1	250		
		47,35432	D
x2	88		

Conditional denotation of colors

A standard value

Entered value

Resulting value

On the basis of obtained data using neural network modeling has been developed a new method of non-destructive method of control using the gain-frequency characteristics, which makes it possible to create control systems that, relying on a verbal description of the two mathematical models of integrated data processing performance of diameters and widths, can monitor the process control parameters details.

For this purpose it is necessary to use the value of frequency filters (x4, x5, x9, x11). By applying a sound signal in the ranges (2000–2500, 2500–3000, 4000–4500, 5000–5500 Hz) the corresponding frequency filter controls integral indicators and as a result we obtain the exact value of the controlled parameter (diameter, width).

The advantages of this control system is the fact that it makes it possible to control not only the quantitative parameters (the length, diameter), but the qualitative (roughness, hardness, presence of internal defects), it is only necessary to introduce additional frequency filters that are configured to control a specific parameter.

If it is necessary the control system can be readjusted. We offer a control scheme (fig. 3), which consists in that the item, falling from the tray on a special metal platform, emits a sound that is transmitted by means of a piezoelectric element on the chip, where the data is processing.

After processing of data the system gives a conclusion about a defective or non-defective detail that can be accompanied by a signal.

Table 2

The output is given for the checking of width system

X9	61,8979	60
X11	58,48668	50
x9	-0,0292	-0,05556
x11	0,175679	0,018519
A1_1	0,176585	0,201853
A1_2	0,256084	0,298198
A1_3	-0,57226	-0,66113
A1_4	-0,12214	0,061384
A1_5	-0,0065	-0,16173
Syndrome1_1	0,150082	0,167952
Syndrome1_2	0,203875	0,229701
Syndrome1_3	-0,36397	-0,398
Syndrome1_4	-0,10884	0,057834
Syndrome1_5	-0,00646	-0,13921
A2_1	0,291744	0,352111
A2_2	0,04269	-0,00767
Syndrome2_1	0,744731	0,778815
Syndrome2_2	0,299179	-0,07124
A3_1	-0,74381	-0,59825
A3_2	0,89848	0,562143
Syndrome3_1	-0,88149	-0,85679
Syndrome3_2	0,899848	0,848975
h*	-1,72162	-1,64604
h	8,27838	8,353958

x1	60		
		8,353958	h
x2	50		

Conditional denotation of colors

A standard value

Entered value

Resulting value

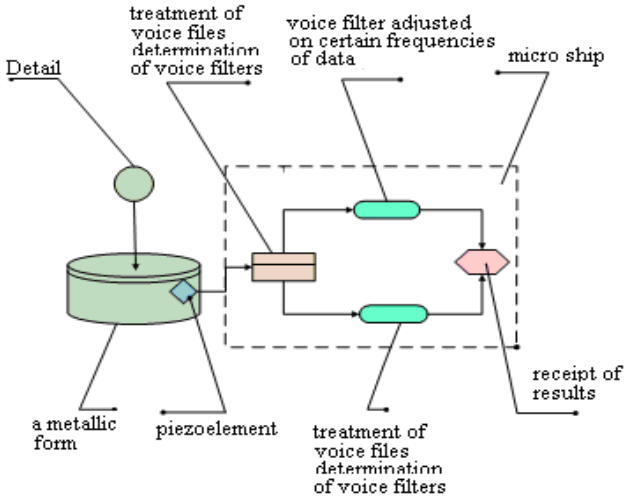

Fig. 3. The chart of the possible checking system

Thus, we have come to the point that it is necessary to continue more profound and careful research of the checking system to show more clearly the advantages and compelling need to use this system in production.

Due to introduction of new non-destructive method of control of machine parts after treatment it is attained:

– it is an exclusion of energy consumption compared with other types of control components (using batteries). Electricity costs are weighty in the manufacture of large parts;

– it is the possibility of obtaining control of quantitative and qualitative indicators by improving the method of nondestructive monitoring using amplitude-frequency characteristic;

– it is the possibility of mechanization of the operation control (fig. 3);

– it is the reduction of labour intensity and time of operation control in comparison with a convenient method of control;

– it is reduction of costs, increasing productivity and improving working conditions due to the mechanization of work in the enterprise.

Implementation of the new control system will reduce the cost of production and current capital of enterprises through reduction of manufacturing cycle time of parts, but will also improve the organization of production at the plant, since the introduction of a new monitoring system will eliminate the delay for manual control of parts.

CONCLUSION

Thus, in this section of the study were discussed issues of improving the method of nondestructive control surfaces of machines and the proposed new system for monitoring the quantity and quality parts. We can do the following conclusions:

– quite a lot of attention to the issue of non-destructive methods of control surfaces of machine parts was revealed in the analysis of the literature on this subject. Questions relating to the new integrated methods of control of machine parts are considered only in scientific articles, abstracts of theses. The issue of control systems is not completely considered, and those control systems that will monitor simultaneously a number of parameters are not considered in general.

– a method of making a research was developed, which allows the use of nondestructive method of control based on the amplitude-frequency characteristics.

– on the basis of data obtained using neural network modeling, a new method of nondestructive monitoring using amplitude-frequency characteristic, which makes it possible to create control systems that, relying on a verbal description of the two mathematical models of integrated data processing performance of diameters and widths, can monitor the process control of the parameters of details.

– implementation of this control in the processing of machine parts in the manufacture of the batch details from 250 pieces enable the economic effect of $ 3172.07 USD, compared to the operation of manual controls.

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