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The Condition Monitoring System Designs Potentially-Dangerous Objects

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Abstract: One of the major tasks for the industrial enterprises is determination of the current technical condition of the equipment in connection with big terms of operation of designs and the intensity of crashes increasing every year, cases of large-scale accidents with big material losses. The study outlines the approach to construction of system for monitoring and control of risk of a condition of technological designs of objects of technological designs. The system allows performing system integration data of deformations of technological designs of objects on forecast of crises situations.

Key words: Constructional risk-analysis, situations, monitoring, determinatio, technological, designs

INTRODUCTION

Objective impossibility of a complete elimination of accidents and accidents require the solution of a problem of ensuring technogenic safety for authorities of territorial subjects of the Russian Federation. One of the important aspects of a problem of technogenic safety is constructional safety. Assessment of risk of designs can be considered as special subject domain of a problem of technogenic safety. The relevance and the practical importance of researches sharply increases in this area in process of extension of the nomenclature of technical systems, increase in their design resources and increase in requirements to safety. Prevention of accidents for the constructional reasons demands studying of circumstances of emergence to identification of the defining parameters, assessment of extreme values and ranges of their safe changes.

MATERIALS AND METHODS

For the solution of a problem of ensuring constructional safety are used now various systems of monitoring directed to creation of the information base allowing to receive, analyze and document in real time data on a condition of elements of the most responsible constructive parts, influencing safety of operation of a controlled object (Denisenko, 2009).

Such approach gives the chance of the timely notification of operational services about the approaching emergency situation when accumulation of adverse deformations happens constantly to the accruing result and approaches critical sizes. In this study, approach to creation of a software and hardware complex of monitoring and control of constructional safety of processing equipment is considered. Creation of systems of monitoring of constructional safety requires the solution of the following tasks:

- Development of means of dynamic deformations and change of provision of elements of designs of observed objects
- The organization of system of collecting, processing and analysis of technological data from measuring devices and their integration in real time
- Integration of diverse data and settlement modules into the complete distributed system of information processing
- Classification of the obtained data and respectively their sources
- Forecasting of dynamics of change and risk of emergence of an emergency on an object
- Creation of a software and hardware complex of control of a condition of processing equipment of the concentrated and distributed industrial facilities

According to solvable tasks the software and hardware complex of control includes three subsystems a subsystem of collection of information from controlled knots (elements) of structures and preliminary data processing:

- Subsystem of integration and accumulation (storage) of data
- Subsystem of the analysis of data and forecasting of situations

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RESULTS AND DISCUSSION

The system is constructed by the hierarchical principle. At the lower level the Intelligent Sensors (IS) which are realizing preprocessing of data and the data collection controller which is realizing integration of the data obtained from IS integrate in a uniform subsystem by means of one of industrial networks (for example, Modbus) which the physical layer is realized on the basis of the RS-485 interface. At the following level the data interchange between controllers of data collection and the server occurs on the Industrial Ethernet network ("industrial Ethernet"). In the case where the location of the monitored object does not allow a wired connection to the server, it is possible to use Wireless Networks (WLAN). At a significant distance, access is the organization of internet access (for example, on channels of cellular communication) with use of VPN technology (Lapina, 2010; Grigorovich *et al*., 2001; Kolesnikova, 2003).

The intelligent sensor represent the combined unit containing the multicomponent sensor of relocation (The patent for the application No. 2009140648/28 dated 02.11.2009) (set of primary transformers) and the controller, containing secondary transformers and realizing preliminary data handling from the sensor and also turning on the interface unit for interaction with the data collection controller (Komleva, 2011; Kubrushko, 2001; Zyryanova *et al*., 2016).

The multicomponent sensor of movements (deformations) except the channel of measurement of movements has the channel of measurement of effort of deformation (The patent for the application No. 2009140648/28 dated 02.11.2009). The sensor used at creation of system of monitoring and control includes eight piezo elements located in a ring of a sensitive element (Zagvyazinsky, 2008).

Feature of the sensor is an opportunity to perform measurement of radial components of movement irrespective of orientation of a force-sensitive element in space. Piezo elements are focused and connected in electric circuits in such a way that the output signal depends only on one component of movement which is measured by this channel that allows to fix not only the size of effort of the deformation arising in object designs but also her direction. Besides, the sensor has high reliability and small dimensions.

In the multi-component sensor, the force-sensitive piezo elements transforming deformation of stretching or compression to the frequency signal are used. The piezo element 0 is intended for formation of a signal of reference frequency. Signals from generators which frequency is defined by the appropriate piezo element arrive on adders and further on the Low Pass Filters (LPF). Comparators create square pulses of the required logic level.

Thus, on the microcontroller signals which frequency is equal to the difference of the frequency set by the appropriate piezo element of the multicomponent sensor and reference frequency. The microcontroller realizes preprocessing of data (filtering on the sliding average, etc) and on demand transfers result to the data collection controller.

Operation of a subsystem of data collection happens as follows. Controllers of data collection make cyclic (it is possible also selective) inquiry of intelligent sensors and perfrom calculation of controlled parameters on the basis of data retrieveds. By results of comparing of the calculated value and an admissible (safe) interval of a deviation the controller makes the decision on immediate data transfer in an analysis subsystem, saving information on an event in a local memory and also on involvement of the means of indication of a dangerous status connected directly to the controller (in case of their existence). It allows to reduce the volume of a network traffic, computing load of components of higher level and also a possibility of an offline operation (Zeer and Pavlova, 2009).

Changes are also transferred to the central database where they update the parameters connected to a current status of subjects of monitoring.

By means of multicomponent sensors and a subsystem of collection of information from controlled knots of designs the first two problems from listed earlier are solved: development of measuring instruments and creation of a subsystem of accounting of data. It should be noted that receiving basic data defines an opportunity and completeness of realization of tasks of the analysis therefore measuring instruments are of particular importance. The solution of problems of classification of the obtained data and according to their sources, forecasting of dynamics of change of indicators and risk of emergence of an emergency on an object can be executed by means of neural networks with various structure and specifics or different ways.

The subsystem of integration and accumulation of data located on the server provides the useful information which is contained in signals of measuring instruments. The number of possible parameters which register can be quite big, therefore, election of the most informative parameters bearing necessary information on dynamics of deformations of surfaces of objects is very important.

Calculation of parameters of deformation, objects $\{u_1, ..., u_n\}$ has to be carried out both in stationary and in

dynamic the modes. In the stationary mode indicators on control points pay off with the certain fixed interval. The values received on the current step are compared to values of the previous step. At the set divergence of values new values of indicators are remembered in the system of monitoring, otherwise are ignored.

In the dynamic mode speeds of change of parameters are calculated. Calculation of the specified parameters is made with the minimum step which can provide the selected monitoring system hardware. All calculated values are remembered in a monitoring system databank (level of collection of basic data).

In case of registration of signals of the multi-component sensor the following parameters register: A_i the fixed values signal Amplitude, exceeding the given threshold P. The T the period of fixing of deviations, time from exceeding is up to one leaving lower than threshold value, number of the sensor defining a controlled point of an object, a signal of I of the piezo element defining the direction of deformation, the deformation effort fixed by the multicomponent sensor (Petryakov *et al*., 2012; Romantsev *et al*., 2012).

CONCLUSION

The multi-component sensors set on a surface of an object and which are a part of intelligent sensors perceive change of deformation of constructions of an object $\{x_1(t), ..., x_n(t)\}$. At the request of IS parameters of deformation of objects are calculated $\{u_1, ..., u_n\}$ also transmit results to data collection controllers. The controllers recalculate the obtained deformation data into the values of the monitored state indicators $\{s_1(t), ..., s_n(t)\}$, compares to limits of admissible deformations of an object $\{w_1, ..., w_n\}$ also transfer this information further to the server. The user interface of the client software set in workplaces of operators gives the chance to control a type of data mapping about a trend of parameters to define the quantitative measure values of deformations in the selected points, their temporal binding to compare with the events arising in system and to see a legend of all displayed diagrams.

The calculated ratios for assessment of risk of emergence of critical deformations of elements of designs of controlled objects at examination of safety are received on the basis of the rated probabilistic models considered in information approach to constructing models of objects in monitoring systems and information and statistical criteria based on entropy estimates normal a condition of an object and estimates of risk of a deviation is defined by probability that the value won't exceed value (Grigorovich *et al*., 2001):

$$P\left(\hat{H}\right) = \frac{1}{\sqrt{2\pi\sigma}} \int_{-\infty}^{H_0} \exp\left[-\frac{(H-H(q))^2}{2\sigma^2(H)}\right] dH \quad (1)$$

Thus, the offered approach to construction the system of constructional safety of potential and dangerous objects allows to control in real time indicators of deformations of the designs of processing equipment characterizing conditions of an object, allowing to prevent emergence of crisis situations.

REFERENCES

Denisenko V.V., 2009. Computer Control of the Technological Process, Experiment, Equipment. Hotline Telecom Dubai, UAE., Pages: 608.

Grigorovich, V.G, S.V. Yudin, N.O. Kozlov and V.V. Shildin, 2001. Information methods of quality management. RIA. Stand. Qual., 1: 106-107.

Kolesnikova, I.A., 2003. [Fundamentals of Andragogy]. Akademiya Publishing House, Moscow, Russia, Pages: 240 (In Russian).

Komleva, S.V., 2011. Pedagogical conditions of the organization of vocational training of workers of small enterprise. J. Nauka i Studia, 13: 58-62.

Kubrushko, P.F., 2001. [Subject Matter of Vocational Pedagogical Education]. Izdatel'stvo Vysshaya Shkola, Moscow, Russia, Pages: 236 (In Russian).

Lapina, T., 2010. Information approach to constructing models of objects in monitoring systems. Inf. Measuring Control Syst., 7: 39-42.

Petryakov, P., M. Pevzner and O. Graumann, 2012. [Corporate pedagogy: The Concept of Technology and Corporate Training, Learning and Educational Management in Organizations]. Palmarium Academic Publishing, Saarbrucken, Germany, Pages: 372 (In Russian).

Romantsev, G.M., V.A. Fedorov and A.G. Mokronosov, 2012. [Vocational education in the system of the modernized economy provision with staff (In Russian)]. Universitetskoe Upravlenie Praktika Analiz, 6: 6-13.

Zagvyazinsky, V.I., 2008. [Theory of Education: Modern Interpretation]. Akademiya Publishing House, Moscow, Russia, Pages: 192 (In Russian).

Zeer, E.F. and A.M. Pavlova, 2009. [Subjective prerequisites of personal autonomy of individual entrepreneurs (In Russian)]. Educ. Sci. J., 10: 40-48.

Zyryanova, N.I., V.A. Fedorov and E.V. Zaitseva, 2016. Modern requirements to preparation of professional and pedagogical personnel. Intl. J. Environ. Sci. Educ., 11: 8800-8810.