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Identification Approach to Creating Software Analyzers and Their Algorithms

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ABSTRACT: This article presents virtual measuring devices and discusses their use. Virtual measurement devices provide insights for developing new measurement systems, analyzing and optimizing existing methods, as well as determining measurement uncertainty and correcting systematic errors based on models. The process of virtual measurement includes not only measuring instruments, but also the sample and the interactions between them.

KEYWORDS: software analyzer, identification analysis, sensor imitation, virtual measurement technology, mathematical models, measurement uncertainty, numerical simulation.

I. INTRODUCTION

Necessity of working out of methods of the identification analysis and creation on their baseline of software analyzers in problems of automation of technological manufacture is caused by an intensification of use of modern information technology in the industry. Achievement of competitive advantage in the conditions of the modern dynamical market for producers becomes impossible without maintenance of the greatest possible informational transparency and adoption of optimum administrative solutions.

The intellectual maintenance of the modern integrated control systems of manufacture should promote as much as possible to adoption of rational and effective administrative solutions. Estimating a value in this aspect gets use for a control system of a certain flow process in most total storage both leaking, and the retrospective data about flow processes and situations at different levels. All these data arrays allow to form new knowledge that allows to produce control actions on each separate section with as much as possible operative use of the aprioristic information on all processes on installation [1] in a real time.

Currently, research is carried out on the development of virtual analyzers. They are software-algorithmic complexes in which models are used that link the operational-measurable indicators of instrumentation with laboratory control data. The efficiency of the technological process depends on the quality of the resulting model of virtual analyzers.

II. PROBLEM DEFINITION

To simulate sensing transducers, the mathematical models based on simplification of difficult physical processes, are often used numerical modelling of investigated process which is defined by boundary conditions and input parameters. Sampling of simplifications restricts conditions of use [2] at which models, hence, results are valid.

For formation control actions can be used the following:

- As recommendations - system of a support of decision-making (it is possible, on other section or on other level of the hierarchy manufacture);
- As management - in the closed contour of automatic control system;
- In the capacity of information for the subsequent generalization and knowledge base replenishment;
- For the analysis and the forestalling of non-staff situations etc.

Formation of control actions on the basis of all listed data arrays, and also uses - in the capacity of additional an input information component of a vector - current results of modelling of other flow processes (or their fragments), provides construction of model of an investigated flow process with adjustment in a regime of normal functioning. Therefore, process of construction of model can be interpreted as identification process, however, in a little wider aspect. This process is offered to name the *identification analysis,* and its software and algorithmic implementation - software analyzers.[3]. The concept of software analyzers within the limits of the present definition is slightly wider, than in a matching nomenclature of known narrowly specialized softwares. However, such definition logically embraces all workings out merged by a principle of construction and correction of models of flow processes under the operative data, per se - measurements on indirect parameters.

It is necessary to note that the *software analyzer*, being the processor for machining of materials and the information, includes actually physical manufacture, a subsystem of decision-making and the informational subsystem. Last two together make a basis of informational-operating system (fig. 1).

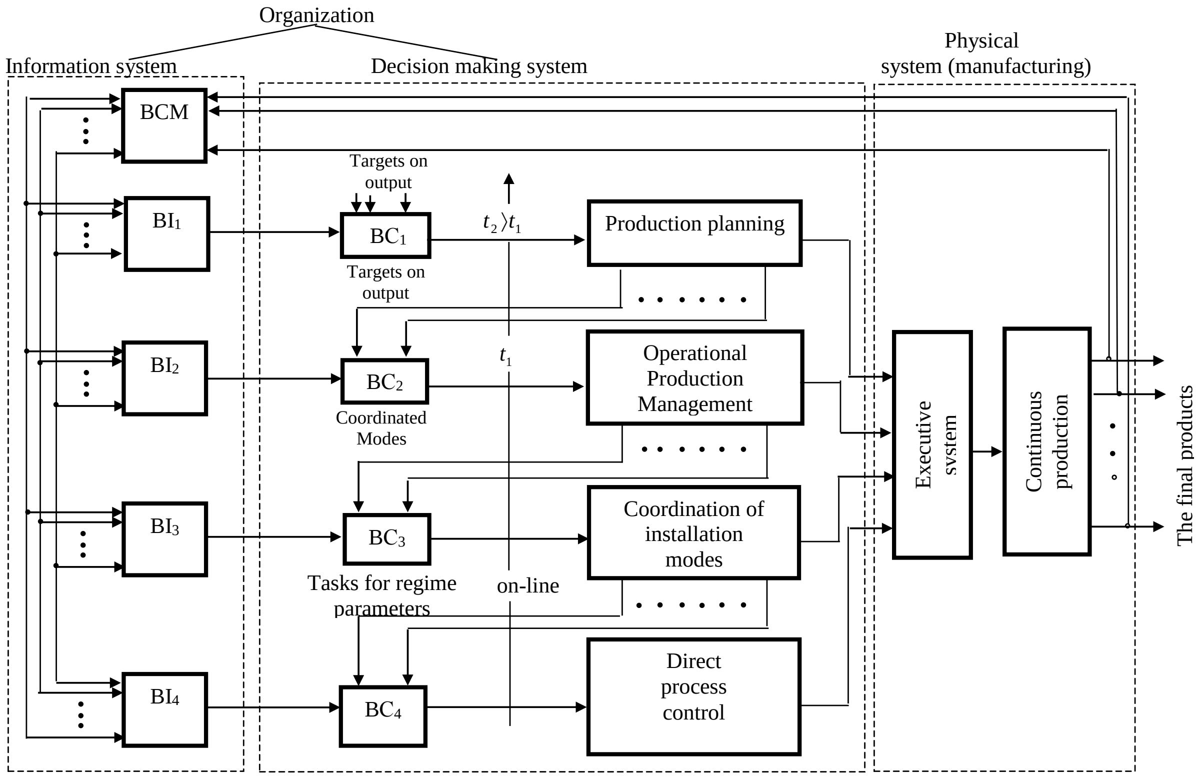

Fig. 1. The circuit design of representation of the organization:
BCM - the block of current measurement; BM - the integration block;
BC - the comparator.

Software analyzers of a work cycle of manufacture are oriented on a problem solving of improvement of quality of a released product at all stages of manufacture, operative definition of optimum regimes of functioning for various criteria of efficiency in a current situation, and also maintenance of reliability of functioning of the industrial equipment. They carry out the analysis of a current situation and process research as installation of management real time, forecasting of quality of a target product for the chosen technological regime, formation of optimum control actions for the set criterion of performance. However, in certain working conditions be claimed all possibilities of the SAs can not. In this case functions of the software analyzer can be restricted only to creation of the informational basis for system of current management of type MES.

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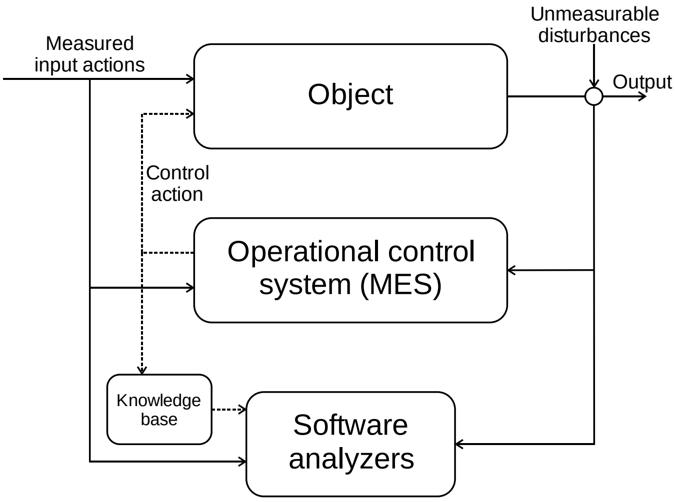

Fig.2. SA as an information basis of operational management systems.

Another production situation is possible when a software analyzer performs the functions of research, identification [4-7], updating technological knowledge, generating information flow for managing enterprise resources, coordinating the work of interconnected industries, etc. At the same time [8, 9], that is SA carries out a more general mission, as reflected in the conceptual diagram (Fig. 2.)

For many industries (industrial facilities, exchange processes and banking operations, etc.), one of the main management requirements is high reliability. At the same time, the high performance of such facilities causes large economic losses in case of failures. In some cases, the lack of completeness of information about the object leads to the need for robust control, which guarantees the operation of the object within the framework of technological requirements and ensures the quality of the produced product in the acceptable ranges determined by the technological regulations. Therefore, the study of the possibility of using the theory and methods of robust control in software analyzers of technological processes of production is promising and economically justified.

When constructing models of technological processes of continuous and semi-continuous production, it is necessary to solve the problem of identification in conditions of small samples of observations. The choice of identification algorithms should be determined in this case by the decay rate of transients in the identifier, and, moreover, by a low sensitivity to the accuracy of the initial approximation [10].

With reference to the class of finite density of distribution of interference at the output, it is possible to construct rather simple estimation algorithms with the characteristic of the “dead zone” type, which have a high convergence rate and allow to obtain highly consistent estimates of the object parameters, including in cases when the input sequence is random vectors whose components are time-correlated sequences of random variables, which is relevant for a very wide class applications.

III. SOLUTION TO THE PROBLEM

The solution to the problem of the synthesis of optimal discrete control systems involves the use of the concepts of optimality, both the structure of the control device and the optimality of adaptive identification algorithms. The development of optimal algorithms in the case of incomplete a priori information is associated with the introduction of the concept of optimality on a class, depending on the nature of the information on the density of interference distribution.

The construction of optimal algorithms is directly related to the adequate assignment of an object to a certain class [11].

As for the object models, for a wide class of technological processes a sufficient degree of adequacy is ensured by the linear parameters of the object model in the presence of the stationarity hypothesis. The basis for this simplification, despite the obvious non-linear and non-stationary nature of a wide range of processes, provides a relatively slow change in the parameters of the feedstock and the parameters of the object itself.

Real-time identification algorithms represent recurrent procedures (stochastic gradient or pseudo-gradient) with respect to a given quality functional. In this case, the identifier performance is determined by the information on

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the distribution of disturbances.

To identify linear objects, the most often used is the recurrent least squares method, as well as simpler algorithms with linear transformation of the residual without recurrent matrix inversion.

The use of such algorithms is also due to the monotony of the transition process in the identifier. With the obvious advantages associated with ease of implementation, it should be noted the lack of noise immunity of linear algorithms. This is due to the following factors:

- their great sensitivity to unreliable measurement results, which leads to the need for preliminary rejection;
- linear algorithms are inefficient with sufficiently good initial parameter estimates;
- in the class of algorithms with a linear characteristic, an increase in the accuracy of estimation is possible only by reducing the step, which leads to a slowdown of transients in the identifier and may conflict with the assumption that the object is stationary.

In order to reach a compromise between accuracy and identifier speed, in particular, nonlinear transforms of the dead zone type can be used, which do not alter the steepness of the characteristics of the algorithm, and, at the same time, provide acceptable noise immunity.

Consider a regression object with unknown parameter $\theta^* \in R^n$ described by the equation

$$y_t = \theta^{*T} x_t + v_t, \ t = 1,2,..., \ v_t \in R^1, | v_t | \le \delta. \tag{1}$$

with the restricted handicap v_t, and observations $(y_t, x_t) \in R^{n+1}$. Let the handicap on an exit of installation (1) is restricted and accepts values in the set interval $(-\delta, \delta)$.

Let's assume that the estimation of parametres of linear installation is made by means of following algorithm:

$$C_t = C_{t-1} + \left[f(y_t - \hat{y}_t) \cdot x_t \right] / \|x_t\|^2, \ \hat{y}_t = C_{t-1}^T x_t, \tag{2}$$

which characteristic $f(\bullet)$ is monotonous. Let the handicap on an exit of installation (1) is restricted and accepts values in the set interval $(-\delta, \delta)$.

Let's assume also that x_t represents periodic (with the period t) sequence of in pairs orthogonal vectors: x_t, = {0... 01... 0}. The adaptation error fulfils to the difference equation

$$\theta_t = \theta_{t-1} - f(v_t - \theta_{t-1}), \tag{3}$$

where $\theta_t = \theta^* - C_t$.

For monotonous decrease of an error it is necessary, that the inequality was carried out:

$$|\theta_{t-1}| \ge |\theta_{t-1} - f(v_t - \theta_{t-1})|, \tag{4}$$

and since the initial estimates are chosen arbitrarily, the inequality must be satisfied:

$$\max_{|v| \le \delta} |\theta - f(v - \theta)| \le \theta. \tag{5}$$

The last inequality, in particular, is satisfied by an algorithm with a dead zone:

$$f(z) = \begin{cases} z - \delta \, sign \, x \ npu |z| > \delta \\ 0 \qquad\qquad npu \ |z| \le \delta \end{cases} \tag{6}$$

The study of the assumption of limited interference is essential in the study of the convergence of the algorithm with the deadband (Fig. 3).

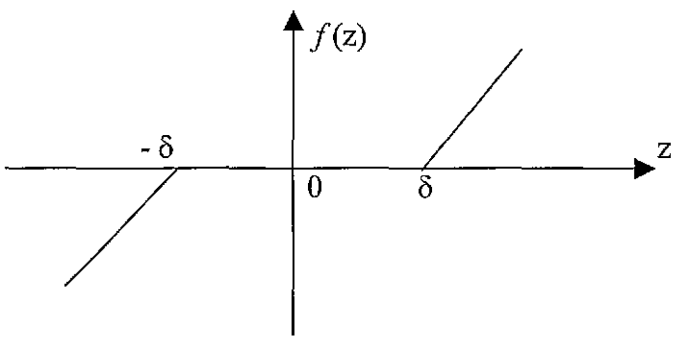

Fig.3. Static characteristic "dead zone"

When choosing the deadband, it should be borne in mind that if it overlaps the limits of interference, the adaptation stops too early, and the accuracy of the estimates obtained may be unsatisfactory. If the insensitivity interval is unjustifiably narrowed, then the algorithm approaches in its properties the Kacmazz algorithm and exactly coincides with it when the dead zone degenerates into a point. As a result, reducing the deadband reduces the noise immunity of the algorithm.

Essential for the use of algorithms with a dead zone is the assumption of independence in the totality of the members of the sequence of inputs. The study of the convergence of these algorithms in conditions where the input sequence satisfies the condition of strong mixing.

The study of the convergence of identification algorithms is even more complicated in the presence of a feedback loop. The degeneration of the information matrix of the object becomes probable, and the small variation of the control and disturbing influences makes it impossible to unambiguously restore the parameters of the object. An effective method of identification under conditions of correlated inputs and limited interference is the method of introducing test actions into the control channel with sufficiently rich spectral properties. However, the introduction of test actions is technologically possible not for all objects. Therefore, it is important to build identification procedures of a different type that would allow one to obtain highly consistent estimates in terms of dependent inputs, and, moreover, provide a performance gain.

Further weakening of the requirement of independence of inputs appears as an actual independent problem, the solution of which significantly expands the possibilities of using the described algorithms in virtual analyzers of technological processes.

Let's return to the description of linear installation (1) and we assume now that $x_{ti}$and x_{si}, generally speaking, are dependent at any $t = 1, 2$, $s = 1, 2...$, $i = 1, n$, but x_{ti} and $x_{tj}$are independent at $i \neq j$

The fulfillment of the last inequality imposes certain restrictions on the input sequence, but they seem quite natural. In fact, it reduces to the requirement that the minimum of the non-zero components of the vector of input variables with a positive probability exceed a predetermined positive constant. This condition, in particular, implies the inequality $x_t = 1$ for any fixed t, which is essential for convergence in the mean square, even in the case of independent inputs. In addition, inequality (6) ensures that the covariance matrices of the inputs are nondegenerate for any fixed t.

IV. INFERENCE

In this paper, we investigated the model of a virtual analyzer with an automatic control system. It should be noted that virtual analyzers are the most accessible means of monitoring the state of the technological process in enterprises. Their main advantages are the availability in use and use, the relatively low cost of obtaining models and the speed of updating data.

REFERENCES

1. U.A.Ruziyev,M.K.ShodiyevIntellektual'nayasensornayasistemaizmereniyavyazkostinaosnovechastotno-fazovogometoda. Khimicheskayatekhnologiya. Kontrol' iupravleniya. 2014.№4 pp.45-49
2. U.A.Ruziev, M.K.Shodiev increasing the reliability of the measuring information of quality of liquid products. Chemical technology. Controlandmanagement 2015, №3-4.
3. Yager R.R., Zadeh L.A. (Eds.), Fuzzy sets, neural networks and Soft Computing, VAN NoxtramdReinold. - New York, 1994. – 440 p.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 7 , July 2019

4. Aliev R.A., Barak D., Chew G. at all, Soft Computing:Fuzzy Logic, Neural Network and Distributed Artificial Intelligent. F.Aminzadeh, Jamshidi M. (Eds.), PTR Prentice Hall Englewood Cliffs. - New Jersey, 1994. – 301 p.
5. Zurada Y.M., Marks R.J., Robinson C.Y. (Eds.). Computational Imitating Life, Piscataway. - NJ: IEEE Press, 1994. – 448 p.
6. Pearson D.W., Stele N.C., Albrecht R.F., (Eds.), Arificial Neural Nets and Genetic Algorithms: Proceedings of the International. Conference In Ales. -France, 1995. -552 p.
7. Ruziev U.A., Shodiev M.K. Virtual analyser of quality of liquid products Chemical Technology Control and Management 2018 Volume 4-5 – pp 178-181
8. Ruziev U.A., Shodiev M.K. Measuring of Viscosity of the Liquid with the Tapering Device InternationalJournalofAdvancedResearchinScience, EngineeringandTechnologyVol. 4, Issue 10 , October 2017
9. Uskov A.A. Gibridnyyeneyrosetevyyemetodymodelirovaniyaslozhnykhob"yektov: Monografiya [Tekst]/ A.A. Uskov, S.A. Kotel'nikov, Ye.M. Grubnik, V.M. Lavrushin. – Smolensk: Smolenskiy filial ANO VPO TSS RF «Rossiyskiyuniversitetkooperatsii», 2011. – 132 p.
10. Kostenko A.V. Virtual'nyyanalizatorsyr'yevykhpotokov [Tekst] / A.V. Kostenko, A.A. Musayev, A.V. Turanosov // Neftepererabotkaineftekhimiya. – 2006. – № 1. – pp. 35–44.
11. Kruglov V.V. Iskusstvennyyeneyronnyyeseti.Teoriyaipraktika [Tekst] / V.V. Kruglov, V.V. Borisov. – M.: Goryachayaliniya-Telekom, 2002. – 382 p.

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