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FEATURES OF OBJECTS OF NON-STATIONARY DYNAMIC CONTROL

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Abstract: *nowadays, in the industry, a high degree of automation is gaining ground at any stage of material/substance processing. The use of systems for automatic control of production processes is conditioned by the need to increase the level of security of the course of the technological process (TP), as well as an increase in the economic indicators of devices and production in general. As a rule, many of the technological processes (devices) found in the industry provide non-stationary control objects in themselves.*

The article scientifically investigated the peculiarities of non-stationary dynamic control objects.

Keywords: *technology, dynamic management, object, economic indicator, technological process, industry, globalization.*

INTRODUCTION:

As is known, nonstationarity is an important characteristic of the technological process (TP) as an object of management and is primarily due to changes in the properties of the technological process under the influence of changes in environmental conditions, changes in the properties of incoming raw materials, internal changes associated with the conversion and replacement of equipment in the technological process, their production and wear.

As a rule, technological processes will have a large number of some controlled (observable) incoming magnitude and some kind of controlled outgoing magnitude, so in the general case, technological processes will have to be viewed as non-stationary dynamic objects with several inputs and several outputs.

RESEARCH MATERIALS AND METHODOLOGY

A non-stationary system can be stable in the same single parameters of an object, and – unstable when the parameters change. The presence of nonlinearity in control systems complicates their analysis, as nonlinearity leads to changes in the fields of stable and unstable states depending on the parameters of the system and the magnitude of the effects. In this, many turns of stable and unstable areas of operation of automatic control systems occur. Therefore, in order to obtain stability in such systems, it will be necessary not only to compensate for the effects of nonlinearities, but also to reduce the degree of nonlinearity and uncertainty.

Most multi-zvenoli inertial systems of modern non-linear automatic control systems will have to be included in non-stationary systems, since their parameters change depending on their mode of operation and time of operation. In this case, dynamic processes in systems are described by differential equations, difference equations or integral Equations with variable coefficients. In some systems, control objects are considered non – stationary, in others – non-linear control laws or non-linear control laws, in the third-both control objects and non-linear control laws are considered non-stationary.

Non-stationary objects can be presented in the form of parametric functions, transfer functions or pulsed transition functions. The use of parametric functions and transmission functions of objects makes it possible to obtain structural schemes that are visual of automatic control systems and simplify the design process.

Equations of state are used to design nonlinear non-stationary systems in the field of time. To describe nonlinear non-stationary systems, an apparatus of differential equations is used, written in the form of a vector-matrix, in the form of a Koshi.

There are many examples of technical objects changing their properties over time. As the fuel burns on a flying aircraft or rocket, the mass changes, from which the dynamic characteristics also change. The activity of the chemical process will largely depend on the properties of the catalyst, which will depend on the time. The dynamics of such objects can be described by differential equations in which they will have variable coefficients, that is, time-dependent coefficients. If an object is described by models in the frequency domain, then a time dependence also arises in frequency descriptions. A model of a non-stationary system in the form of a $g(\theta,\tau)$ pulsed transition function τ - will have a function representation of the time to give the incoming signal and the time to observe the output of the system - θ. For a stationary object, the impulse reaction will depend on their difference $(\theta - \tau)$.

When modeling non-stationary systems with the use of forms of traditional mathematical models, the frozen quotient style is often used. For example, by considering the parameters of the equation as constant, the differential equation is solved for a given time cut. Then it is switched to a different time section, respectively, the coefficients of the model are changed, and again a new differential equation is solved.

Tracking the dynamics of a non-stationary system is considered one of the fundamental problems of control theory. For Real-world technological process(TP), it would be necessary to have a mathematical model of the control object capable of working in Real-time scale and capable of adaptive correction depending on the change in the properties of the object. The calculation of the parameters of the model in Real-time scale should be carried out in such a way that at each step the processing of measurements will end until the next step begins.

RESEARCH RESULTS AND DISCUSSION

Non-stationary object research techniques rely on stationary object research techniques, and in most cases are considered to be their generalization. Two main approaches can be distinguished in the identification of non-stationary objects. In the first case, the transition from the issue of parameter estimation to the issue of parameter tracking is carried out. This approach is based on the use of flexible identification algorithms. On the basis of another approach lies the desire to exclude non-stationary elements from the mathematical representation of the non-stationary technological process, which is common in engineering practice, and move on to the calculation of systems with constant parameters.

The classical theory of the construction of models of a control object-identification — is built on the assumption that in practice there are some kind of non-random parameters that characterize the behavior of complete control objects as stationary and these objects. Targeted identification algorithms for determining the coefficients of a stationary object are constructed, as a rule, non-stationary.

This allows them to provide such properties of the obtained estimates as asymptomatic approximation to the coefficients of the model, non-slip, etc. The developed optimal identification procedures provide the smallest error in determining the coefficients in a given number of experiments. In this case, the descriptions of the identification process will largely depend on time. The larger the observation interval, the more accurately the coefficients of the object are determined when other conditions are equal. The nonstationality property is characterized by the following algorithms: classical LSM(least square method), stochastic approximating style, and other identification algorithms.

Further development of the use of LSM has led to the emergence of various modifications of this style: generalized LSM(Markov estimates), balanced least squares style, slang function style, etc. In addition to LSM, there are other identifiuction techniques that have their applications, such as methods based on a probable approach: estimating maximum factual similarity, estimating Maxima of aposterior information, Bayesov estimation, stochastic approximation algorithms, etc.

The general requirements for identification methods are such that the identifiable estimates of the parameters of the model must be accurate and identifiable quickly enough.

Accordingly, methods for evaluating parameters:

- be expressible in a sufficiently general view of the space of;
- to be easy to implement and to provide the speed of convergence that a given moment can receive;
- it should ensure that the optimal estimate of the parameters sought is obtained.

Under more complex conditions – when evaluating non-stationary objects in a closed contour, the Bayesov approach will be productive. Even in the event that it is impossible to implement a clear Bayesov solution, it clearly shows the essence of the issue and helps to build incredible approximations. However, great difficulties arise in the applications of Bayesov solutions. It is required to know the aprior distributions of the output of a non-stationary object and the conditional probability densities of unknown parameters.

It should be noted that the Bayesov approach to the identification of non-stationary objects falls into the styles of nonparametric identification.

A common technique of exponential drag is used in the recurrent calculation of the distribution of the probability of Gaussian density of unknown parameters.

In classical control theory, the issues of analysis and synthesis of most linear stationary systems are solved by the use of models in the form of transmission functions. In this case, differentiating, integrable operations are replaced by ordinary algebra due to the operation calculation. For non-stationary systems, too, the use of models in the form of transfer functions makes it easier to solve most problems, right here now the algebra of matrices is used.

In the development of non-stationary object control systems operating under conditions of prior uncertainty, flexible control, independent control, fuzzy logic, and neurotic adjuster techniques are used.

In systems for flexible control of non – stationary dynamic objects, two fundamentally different stages of work are distinguished-training and management. Depending on the idea adopted in the control system, these stages can be separated and combined in time.

In the first case, at the stage of training, when the structure of the object is known, structure identification or parameter identification is carried out, that is, the construction of the model of the object is carried out. When one or another criterion of the proximity of the output of the object and the output of the model is met, the model is considered suitable for the object. After the Model is built, control begins at the next time interval, which is synthesized on the basis of the information obtained at the training stage and the current information obtained by observations of the input-output of the object.

Of great interest for assessing the limits and possibilities of such a representation of control methods for non-stationary dynamic objects are methods of reduction to equivalent models that allow us to consider the original non-stationary object as a stationary object. A general method for obtaining a stationary model of a linear object with periodic parameters is shown by A.M.Lyapunov.

One of the ways to bring objects with non-stationary parameters into equivalent stationary models is considered to be averaging techniques. On the basis of these methods lies the opera of averaging coefficients that are part of the structure of differential equations or difference equations, which describe the dynamics of the system.

These styles are used for two classes of linear objects with non-stationary parameters, in particular with periodic parameters:

- objects with a small amplitude of repulsive effects;
- objects that have a large riot of high frequency of parameters.

A style based on the theory of hyperbaric and positivity of dynamical systems is also used to address non-stationary dynamic object management issues that operate under conditions of Aprior uncertainty.

In systems with non-stationary non-linear objects, different methods of linearization of the equations of dynamics with respect to the selected base trajectory of the action are used. In this case, a system of Linear Differential, difference and integral Equations with constant coefficients is formed. For other base trajectories, also linearized equations, but equations with other values of constant coefficients are obtained. Due to the fact that in dynamics the transition of an object from one trajectory of motion to another occurs, a non-stationary linear equation is obtained, the parameters of which depend on time.

CONCLUSION

A more effective approach to solving the issues of stagnation of non-stationary dynamic objects, the given static accuracy of adjustment in ACS(automated control systems)in conditions of uncertainty, and the provision of required quality indicators of transition processes is rightfully considered the principle of "deep" reverse coupling. His ideas, which are considered as the basis, are successfully exploited in various forms in the style of large coefficients, the style of sliding modes and mahallization.

Despite the fact that many methods have been developed to compensate for the considered peculiarities of technological processes (within the framework of flexible control theory), they did not have sufficient dispersion in the oil refining industry due to large and frequent changes in the parameters of control objects than in other industries. Thus, the problem of controlling non-stationary and non-linear technological processes by constructing flexible control systems with Real-time readability to show an operational reaction to the mentioned changes in parameters is an urgent problem.

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