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THE CHOICE OF INPUT PARAMETERS ADAPTIV SYSTEMS PROCESSING OF EXPERIMENTAL DATA

Abstract: It is shown that for the automated systems of processing of experimental data needed in the algorithm to provide the possibility of adapting the speed of processing, improved precision, possibility of aggregation of the measurements. Users should be given the opportunity to change the interaction with the system depending on both the parameters of the input data to be processed with fixed or replaceable programs, and the state of the database on a particular subject area.

Keywords: Informatics system, experimental data processing, information-measuring system of stationary Gaussian random process

Entry. In relation to the technical systems (TS), which we will call the set of dynamically linked artificial ingredients, forming a coherent internal structure and with external commitment, the term "adaptation" first appeared in the theory of automatic control, then in electronics and communication and other fields of science and technology. Under adaptive TF (ADTS) was understood by those for whom it was convenient to use the term "adaptation", and the term itself did not require further clarification. Later his steel to determine through not subject to revision terms like "training", "learning", "efficiency", etc., which is not particularly helped to clarify the situation [1].

In a broad sense, the adaptability of the vehicle is the ability of the system to modify itself or the external environment when changing the operation conditions to compensate (at least partially) the loss of performance.

From a technical point of view, adaptation is one of the ways the use of automated equipment, leading to the emergence of qualitatively new properties in the operation of the vehicle. In the technique of adaptation is the highest degree of automation of the TC, which is characterized not only by the presence of backward linkages, but also the obligatory presence of the TC measurement devices and analysis of the results of these measurements, giving a property of memory and has the ability to make some decisions based on analytical and formal reasoning.

From a systemic point of view, adaptation is a continuous process of optimization, so any ADD needs, at least for some time, to maintain its optimality.

From a mathematical point of view, ADD should solve the problem of stochastic extrapolation, that is prediction of the performance of their functions and to maintain it at a predetermined level (e.g., top) within a predetermined time interval.

The General principle of construction of adaptive systems based on the measurement, i.e. obtaining estimates of known (or determined in the process of ADTS informative parameters, the memorization of these assessments and introducing them to the selected machining functionality. It is almost always unclear the optimality of the whole procedure in General, since the valuation type is chosen from the standpoint of measurement theory that involves obtaining estimates of parameters with some error, and the functionality of the processing, from the viewpoint of the theory of testing hypotheses that involves the presence of all (or sufficient information about the object [2].

Understanding optimization achieve the best results of functioning of the TS of many possible variants of its construction, as part of a system of experimental data processing (SPLICING) - level system analysis it is necessary to consider the measuring unit (hereinafter referred to as the information-measuring system – IMS or measuring-computer complex IVK) and the unit of analysis and decision-making [3].

From a theoretical point of view, information-measuring approach ensures the measurability of various sets. The basis for the construction of measurement theory should be the study of topological properties of sets, measure and the topology of measurable sets should allow you to enter the amplitude, spatial and temporary arrangements of the process and come to the concept of information performance characteristics which are reflected in the measurement results[4].

The problem statement is to develop a classification of adaptation parameters in systems of experimental data processing and information-measuring systems(IMS), development common to all systems, their assemblies and units, as well as medium of propagation of signals (information carriers) methodology of measurement of informative parameters, the estimates of these parameters and to optimally coordinate. The basic content. IMS, multi-channel and (or) multi-functional technical device intended for measurements and is a combination of measuring instruments and measuring instruments (OP), primary and secondary transducers (PIP GDP) of the United General functioning algorithm and is designed to obtain data on the object state by some transformations of the set of physical quantities distributed in time and space

If the result of the transformation is named the number [N]= which has the dimension of [1] and obtained as a result of accounts n units, then the transformation is called a measurement; if the logical expressions such as "more, less" - that control. From here follow the differences between IMS and systems of automated control (i.e., human operator) or automatic control (without operator intervention), often abbreviated as SAC.

Systems of experimental data processing (SPLICING) perform all the basic functions of IIS have an additional opportunity of exposure to the object of measurement with the aim of approximation to the target function experiment (error, reliability, cost, resources, etc.).

In these terms the problem of optimizing ADS is reduced to the consecutive decision for both units TS three main stages:

- obtaining analytical expressions for the objective functions (for example, to the measurement errors, which is a decisive indicator of quality of IMS and CONN);

- finding the mathematical relationships for well-defined optimization problems;

the adoption of the decision on one of the selected (or specially developed) criteria.

To assess the effectiveness of any vehicle is necessary to provide a joint analysis of the effect of the use of the vehicle when performing a set of conditions that implement the principles adopted and the cost of its achievement. It uses the technical, economic and techno-economic performance criteria of the vehicle .

Technical criteria (they are many) usually reflect the technical level of the vehicle (i.e. "perfection" from the point of view of developers) or the suitability of the vehicle for the task. However this estimate is biased and is in most cases insufficient, with the exception of those cases when lifted economic restrictions (for example, in the military field, space exploration).

Economic criteria (of course the cost of resources), being more General and universal, does not reflect, in most cases, technical perfection (again, from the point of view of developers) and the dynamics of the vehicle.

Feasibility (complex) criteria are preferable, so always attempt the formation of such criteria for evaluating the efficiency of the vehicle, representing, for example, for IMS, a minimum error in the restrictions on resources.

For most TS there are four different types of adaptation:

- externally-the external, when the vehicle responds to external changes by modification of their environment (exceptions, including the destruction of external sources of interference; shielding, transfer most of the vehicle in another location;

- outdoor-indoor, when the vehicle responds to external changes by

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modification of itself (a typical example is a change in the structure of the optimum receiver signal at changing the character of obstacles), including the self-liquidation;

- internal-external, in which internal vehicle for change responds by modification of their environment (switching on external power sources for energy adaptation, the inclusion of external reserve in case of failure, and methods of duplication and redundancy, etc.;

internally-the interior when the vehicle in response to internal changes, modifies itself (for example, adaptive receivers with internal loop adaptation).

There are various ways and methods for reducing errors of CONN and IIS caused by some differences in the approach to their analysis in theories of measurement, reliability, pereskazhesh (noise immunity) and other related fields of science and technology. Methods to improve the accuracy of the system can be divided into three main groups, including certain principles of adaptation.

1. Resolve themselves sources of errors or their suppression in the center. Typical examples include methods of suppressing industrial interference within these sources (shielding); reducing internal noise blocks and units of electronic equipment during the transition to a more advanced (or fundamentally different) circuitry; weakening of the mutual influence between the channels (temporal, spatial and other types of signal separation in the channels IMS); improving the noise immunity of the system due to the transition of the communication channels is complex and noise-like signals; the transition to a new, non-traditional ranges of the transmission and processing of signals (millimeter waves, optical lines), where the noise level is dramatically reduced; thermal stabilization and thermal insulation (heat reduction); reducing the number of contacts the use of integrated technology; stabilization of power supply sources, etc.

2. Weaken the effect of the error sources in those places the system, where their effect is maximum. This could include the use of spatial-temporal signal processing in the receiving parts of the IMS to reduce the impact of noise; application of the principles of compensation, invariance and complex measurements to reduce instrumental error; redundancy of equipment and integrated controls to enhance reliability, tone and Metrology; application of the principle of feedback (OS) in all IMS, or parts of it in different types (negative, positive, selective, etc.) to reduce measurement error by reducing the internal, reducing linear and nonlinear distortions, suppression of some kinds of interference, etc.; thermostatically, shielding and other

types of protection from electric, magnetic, acoustic and other fields; training equipment to detect failures, etc.

3. Combined methods to eliminate some sources of errors and to reduce action of some other sources.

One of the basic combined methods of influence is the transition from analogue to digital processing of electrical signals, which eliminates the error from nonlinearity, reduces the impact of instability of the transmission path. Through the use of integrated circuits with high degree of integration of binary digital elements, you enable the more algorithms (adaptive, temporal processing of stochastic iterative, etc.) processing and enhances the redundancy of the equipment through the use of standard replacement elements (SRE).

However, together with the use of a number specific to the digital processing efficient algorithms to improve the accuracy, there are new sources of errors, e.g., errors from quantization and error of the algorithms. However, significantly expands the bandwidth of communication channels in IIS that can amplify the effect of other errors, for example, the final execution speed of computer operations. But in most cases analog-to-digital processing allows to increase “aggregate precision“ (exactitude – ET), ET= 1/ CONN and IMS [1].

Most of the objects and signals when measuring parameters of the trajectories of moving objects in a geocentric or heliocentric coordinate systems, seismology in the localization of surface and underground anomalies, radar, hydrography , physical modelling in aviation and space (purge models in aerodynamic tunnels, etc.) described by the models credibility. In the basis of experimental studies in these areas most often is to obtain estimates of the probability of random processes, that is, the statistical measurement of signal parameters. If the information on the studied processes is limited, there is a need for adaptation (in a broad sense), as it is almost impossible to optimize the structure of the measurement system and signal processing, or in other words, to specify the number and statistical characteristics.

In the information-measuring technique currently have spread, along with the traditional, so-called structural techniques improve accuracy [2], is used externally-internal adaptation.

A known structure of the vehicle and a predetermined algorithm for signal processing in the design phase of IMS, taking as a defining indicator of the quality of the error of measurement of some characteristics, it is possible to formulate the

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requirements for one channel of IIS as to some means of measurement (SI), containing the transmitter (IP), which conducts the measurement and getting a measurement result as a named number of units, and specialized computer (analog or digital), which performs optimal on a chosen or given criterion, processing the output signals UI on the background noise.

Obviously, in the detention center, in contrast to the automatic control systems (ACS), the actual value of the input signal is unknown and therefore cannot be assessed as quickly as is the “error” that is the basis for the ACS. In IIS it is impossible to cover feedback to the primary OP, are the main sources of instability characteristics. Therefore, the design of IIS and the UNIT of different levels, including adaptive, it is necessary to take into account the following basic principles:

– the use of informational criteria of effectiveness of adaptation;

– taking into account the degree of a priori uncertainty conditions of work;

– the use of statistical methods of reliability;

– the use of a formalized description of the subsystems of IMS.

Usually in such cases speak about a problem of statistical synthesis with full a priori information about the input signals, that is, when the probability density of the signal and noise are known. If the probability density or some parameters are unknown, it is customary to speak of the problems of statistical synthesis under conditions of a priori uncertainty, and should always be borne in mind that in the absence of a priori information about signals and interference the solution of the problem of synthesis of optimal systems is impossible in principle. However, in practice there is always some data based on previous experience, intuition and physical interpretation of the problem. From the point of view of computer science, the physical interpretation of the problem and intuition relate to the objectives of modelling, the key that is, and the problem of obtaining a priori data to the tasks of formation of knowledge bases for a particular section of science and technology, called on a clear area or Problem area (PRAR) [3].

In the end, you can talk about the development of information (SOFTWARE) and mathematical (MO) the provision of computer-aided design (CAD) within a PRAR (for example, the measurements of roughness parameters in the engineering, waviness of the surface in the aircraft industry, etc.) and principles of adaptation of algorithms of work of the UNIT and IMS. Assuming that adaptive IMS can adapt to changing conditions, modifying its structure, best results are obtained by the implementation of the directed search of variants of the structures is based on certain knowledge, with more highly organized systems rely on a comprehensive knowledge base.

The first level of self-organization of automated adaptive CONNECTION is always focused only on specific PRAR (e.g., expert systems), and operation algorithm of the system is represented by the fixed treatment programs. The program is processing is a fundamental invariant one-level adaptive CONNECTION because such systems are adapted to the current input action and the current state of the knowledge base.

The second level of self-organization AS should allow you to change the program of the main processing, and some of the knowledge base, often referred to as conditionally-constant information (classifications and thesauri), while changing the conditions of operation. The main duplex adaptive CONNECTION there is already a value of the efficiency criterion of the optimization program (for example, IMS - methods of increasing accuracy) and fixed sets of modules (C, MZ and multifunctional elements), which can be collected AS various architectures. To this type of two-level adaptive UNIT is the most modern adaptive CONNECTION [4].

In the process of designing effective number of ideas decreases approximately exponentially while simultaneously not predicted growth of costs, and it may be that during the design of some idea by the end of the design and testing will become obsolete. So the idea of optimization, in this case, the criterion "reduce development time", is obvious. However, the use of optimization methods in "pure form" for the purpose of designing the UNIT difficult because of the fuzzy formulation of the problem and almost always need development specific to this PRAR approach, for example complex of measuring information parameters of signals.

The classical optimization problem consists in the extreme values of a function $f(S_1, S_2, ... S_K)$ in a particular manner adopted by the region specified by the irregularities of the form G or G $(S_1, S_2, ... S_K) \leq 0$ [3].

To solve this problem applies a lot of techniques: linear, nonlinear, dynamic, discrete, convex quadratic (or stochastic) programming with different approaches taking into account existing constraints (the simplex method Danzig; the classical methods of calculus of variations - Euler's equation-Lagrange; gradient methods - principle of optimality R. Bellman). The choice of approach depends on the choice of the objective function and the nature of the constraint that involves the study of the performances for correctness.

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The definition of correctness can be presented in the form, where the solution of quantitative problems with the initial data, are the elements of metric spaces and distances between the elements and, if the following two conditions.

Condition I. the Problem of finding called correct in a pair of metric spaces, and if:

– define the concept of solution, that is, you know, what result and in what form it is desirable to obtain;

Condition II . The problem of finding stable if for any number there exists such that follows.

The violation of at least one of the paragraphs of these conditions testifies to an incorrectness of a task.

The condition for the regularization of large scale problems , where the number of unknowns under constraints a typical example of which is the optimization problem of IIS in any PRAR, can be formulated as an application condition step-by-step optimization suboptimal, is universal. Sub optimization is the governing rule in the optimization of various multi-stage hierarchical structures and therefore often generates an action similar techniques: decomposition, hierarchy, modularity, etc. for Example, the adaptive UNIT determining quality score is the measurement error , the costs of which are in conflict with the value, of course, decreases with time.

Summarizing the requirements for the selection of quality indicators ADTS with recommendations:

– scientific solutions and design methods, in which claims of reliability, including Metrology, are required;

– of paramount importance for most of the UNIT information value;

– taking into account the fact that the optimal solution must lie in a region of compromises, come to the need to clarify procedures for the formation of indicator of the quality of the system.

It is obvious that the physical nature of the process of formation of the quality indicator is based on the principle of comparison with some standard, for which known or formulated at the stage of the external design of the basic and optimal in a certain sense indicators . Optimization is achieved when the minimum distance between the ends of the - dimensional vectors of parameters determined by many parameters of the reference and the designed system

condition is most significant for a given measure of quality parameters that ensure .

Comprehensive index of quality should reflect the resolution of the main and fundamental for the UNIT compromises:

– between value of information and the cost of obtaining data (measurement results, control). The design of adaptive CONNECTION of the third level of self-organization in most cases comes down to the design of any duplex adaptive CONNECTION, in which nvariant have already Metacritic (criteria a higher rank, such as ethical or aesthetic). The source data in the CONNECTION have information about the external environment and possible internal state of the entire set design of the UNIT at lower levels. For this kind of systems are the so-called “intellectual” and some other CONNECTION-based work on knowledge bases that are continually updated, for example, active (radar) and passive detection and classification, global positioning system (GPS) and others.

It is known that the adaptive UNIT is a dialogue system where the dialogue is based on the analysis of the information obtained as a result of decisions strictly formalized tasks on the basis of mathematical modeling methods. For each class of designed systems, the substantive aspect of the procedure description (formalization) has its own specifics and in many cases, for example in medicine, is unique. This thesis gives reason to believe that it is impossible to create a universal adaptive CONNECTION, invariant to PRAR. The situation is similar with the development of expert systems, because of the proven universal methods effective in limited cases. However, the basic principles established in the Foundation of the building, as the expert systems and the UNIT for various purposes, most likely, are integrated and can be used in their design.

Thus, any adaptive technical system must continuously solve the optimization problem, or, in other words, solve the problem of stochastic extrapolation (forecast) random processes . Statistical forecasting methods allow us to estimate future values based on measuring previous and current values of the specified characteristics of reliability. In exact, although quite cumbersome, methods of forecasting include modern methods (especially simulation) computer modeling. Provided for in some way the values of informative parameters are the initial data to generate or control actions, or for decision-making.

In automatic control systems (ACS), for example, the translation of these data to the control action consists of a series of mathematical and logical operations performed by analog or digital processors. One of the most important tasks is

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designing efficient algorithms for processor performance under given (or selected) parameters like accuracy, speed, etc. It is always necessary to keep in mind that the composition of any system of controls is always a unit (host device) measuring the error signal, having structure IIA. Conclusions

The developed classification of adaptation for the systems of processing of experimental data and information-measuring systems can allow to reduce unreasonably overestimated requirements for elements of systems and to significantly reduce the time and cost of their development, which is a promising direction in the development of adaptive SOED and IVT.

Therefore, an external-internal adaptation is most appropriate in an adaptive EMF to which the IBC is integrated, a typical example of which is structural methods for improving accuracy and, to a lesser extent, internal-internal adaptation.

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