THE REALITY OF PERSPECTIVES OF EQUIPMENT INTELLECTUALITY. THE PECULIARITIES OF SYSTEM DYNAMICS DEVELOPMENT OF N-LEVEL IN THE PROCESS OF INTERACTION BETWEEN (N-1)-LEVEL SYSTEMS.

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Abstract

In the report there offered for the discussion the analitycal and synthetical system typologhes, which offer to separate in a definite way the inanimate, artificial and living systems. The memory structure of a self-developing living system should be understood as "intellect". The modern difficult artificial systems are shown to come close in there structure to the living systems. On the bazis of consideration the interactions between (N-1)-level systems there have been shown two evolutional curves of the living and inanimate N-level systems. Under consideration there is the opportunity of equipment intellectualization by means of giving to it the properties of the self-developing living systems. The latter is possible when imitating in the mathematical mediums the interacting memory structures analogous to the living structures.

Introduction

At present the science and engineering came to such limit of technical systems functioning difficulty, when the only conjugation of apparatus complexes with a man-receiver is already not enough. More often there appears a necessity of technical systems, which can not only take self-dependent decision, but also to be an intellectual partners of a man.

From our point of view, the solution of this problem one should search in that field of theoretical abstractions, where in close unity one can consider the most principle functioning moments of artificial technical systems and natural ones. Therefore, the aim of the very report is to make specialists acquainted with analytical and synthetical typologies of systems, got as a result of our investigations, on the basis of which we hope to demonstrate the perspectives of equipment intellectualization.

The analytical typology of systems.

As the basis of the very typology does not relate to the number of those known, we would like the respected readers to pay attention to the reasonings, written below, before coming to the typology proper.

Let's consider the arbitrary material system. It detects itself at first by its being concret and unique, due to the very system's interaction totality between its subsystems. At least every subsystem can also be considered as an independent system. Let's assume the subsystems as an elements of system under consideration.

In fact, system is a close unity in space and in time. How one can interpret it? Let's take any moment of time t_o. At that very moment the system has some form F_{mom} made up of its elements. The existing of this concret momentary form provided by the superposition of elements, interacting between each other, and it can be presented in the following way:

$$F_{mom} = \sum_i I_i \times f(t_o, I_i), \quad I_i \in I, \quad i = 1,2,3... \quad (1)$$

where F_{mom} - the form of the system at the given time moment t_o;
I_i - i-th element of the system;
$f(t_o,I_i)$ - a function of elements space distribution at time moment t_o.

The peculiarity of $f(t_o,I_i)$ is that it is especially non-linear, though because the system has the bounds, beyond the bounds of which $f(t_o,I_i)=0$, and within the system it is essentially differs from the zero. Due to it, namely on the system bounds f(to,Ii) demonstrates its non-linearity, determining the external system form in space. We shall call F_{mom} as the information system index.

Besides the space unity, which we have expressed through the information index F_{mom}, the system also demonstrates its form unity in time, that can be interpreted as the reaction inertiality on the external influences. For example, due to the sharp increase of external medium temperature, the increase of system temperature is going with a delay, which is determined by the inertial period τ. Let's designate the system form in time as the general form $F(\tau)$. It's obvious that $F(\tau)$ can be expressed through F_{mom} in the following way:

$$dF(\tau) = F_{mom}dt, \qquad (2)$$

where $F(\tau)$ - the general system form;
dt - time interval, which is much smaller than inertial period τ.

Finally $F(\tau)$ for the time period $\tau=t_1-t_o$ can be presented in the following way:

$$F(\tau) = \int_{F_o}^{F_l} dF = \int_{t_o}^{t_l} \sum_i [I_i \times f(t_o, I_i)]dt, \qquad (3)$$

On the ground that system inertiality determines in time first of all by the totality of power inter-element interactions, let's call $F(\tau)$ as the power index of the system.

So, we got two system characteristics: F_{mom} and $F(\tau)$ designated by us as an information and power indices. But as is known, system consists of subsystems, each of them can be considered as an independent system, it's easy to see that for each I_i on the lower system level, the same formula (1,2,3) can be used, but taking into consideration the replacement of I_i on $F(\tau)$, that is our formula have recurrent character.

Now let's turn to the determination of systems, which was offered in my report "The method of system analysis in the systematic space. The objective quality criterion of TV reproductions".

System is the totality of elements (or subsystems) united by the information-power interactions general complex into functional unity, which determines the reaction on stabilizing or destabilizing influences. The dynamics of system existing determines as a trajectory of system vector in 4-dimension system-antisystem space (SAS), where:

- power is the power index, determining the inertial system properties (see formura (3));
- information is the information index, determining fully the system form (see formula (1));
- systemity-antisystemity (stability-instability) - determines the character of inter-element interactions complex functioning, which can direct either at the system formation or at the system distruction;
- order (hierarhity) determines the system structure in the sense of its hierarhity. So, the 1-st level system consists of indivisible elements, the 2-nd level system consists of subsystems, which, in their turn consists of indivisible elements and so on.

Let's designate F_{mom} as I and $F(\tau)$ as E. The recurrence of I and E we interpret as system hierarhity (or its order) N. Turning to the system space, we underline that I and E are orthogonal to each other, because $F_{mom}=dF(\tau)/dt$, while I and E are also orthogonal to the system hierarhity N, that is to the order.

Now let's turn to the proper analytical system typology. Let's consider on one of the original levels N the system space section, consisting of two coordinates: information and power (I and E). Suppose we devide all systems of the given order N on three types: inanimate, artificial and living. (Turn your attention to the fact that under living system are meant any living systems , exept clever systems.) At fig.1 shown in vectorial form three system types are. They are different by information sign and normalized by power status (power component E=1). The very system combination on I axis is dictated by the following understandings.

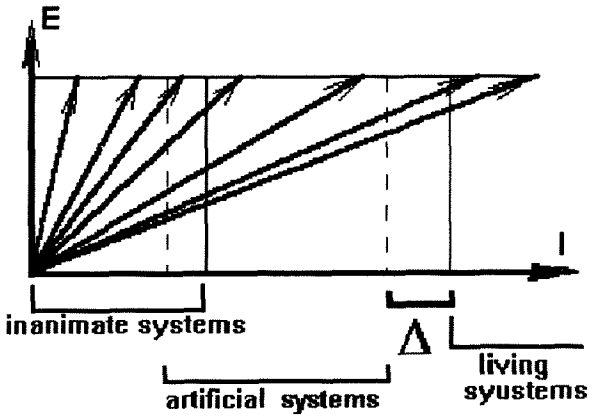

Fig.1. System typology in two-dimension co-ordinates.

The living systems carry in itselves a great information potential, when having high dynamics of their time dimencions, that gives a forestalled information component I level (see formula (1,2,3)).

Inanimate systems. Essentially yield to living systems on information interaction parameter between subsystems and have a low level of dynamics changes in time, that leads to farestalled high level of power component E (see formula (1,2,3)).

Artificial systems take the intermediate position on axis I and differ from the inanimate systems by much number of information sings by means of influence dynamics of separate subsystems. For example, high-organized artificial systems, such as radiotechnical sustems, piloted

or non-piloted cosmic stations, have their information component level, coming close to the living systems. At the same time low-organized artificial systems are practically situated in the zone of inanimate systems.

Δ is a sone of possible but not realized artificial systems.

We would like to underline once again, that we consider quite a definite section of N-level systems, where the living systems already exists. It's natural one can not speak not only about living, but even about artificial systems on quite a low N-levels. At the same time, on very high N-levels, corresponding to difficult, cosmic scale objects (for example, Galaxies) and clever living systems, there is not yet any talk about artificial systems.

Let's return to fig.1. As we can see, artificial systems have their representation among the inanimate systems, however they do not reach the living systems on size Δ. From our point of view, the overcoming of namely this border, when creating difficult artificial systems, determines the begining of a real artificial systems intellectualization, in particular the aviation and cosmic techniques equipment.

For consideration of possible ways of reaching in prospect the real artificial systems intellectualization, let's turn to the synthetical system typology.

The elements of the synthetical system typology.

The system synthesis (real or imitational) is practically impossible without shaping a concrete form to the future system. The system analysis in the SAS offers to analyse the already existing forms, but does not offer to synthesize the required to us systems. That is, the analysis can confirm or disprove the synthesis result,but not more. What can we take as the basis of system generation,when synthesizing for getting the totality of wishing linear and non-linear connections between subsystems of a future system? From our point of view, when synthesizing systems, there can be mostly used such index, as memory. We offer however not a typical treatment of the word, but somewhat wider. Memory is a property of a space-time continuum to determine in time the result of a reason-investigation relations between objects of a real world on every ordinal levels of system existing.

Let's turn again to formula (1,2,3). From the positions of memory determination we interpret τ as inertial system memory (IM). With that, any system has the division surface. Namely this border meets the external influences, on which all system reacts through the time interval τ. Due to it we shall interpret as a momentary memory of the system border (MM) the time dt from formula (2). Such an approach offers to present any system in the way, shown on fig.2.

Now let's imagin two systems: the inanimate system and living one, for example a stone and a cat. During the sharp changing of an external medium temperatute a stone, through some time, which can be determined by its inertial period, will also get warm. At the same time the cat's fur will only get warm, but cat itself will not change its temperature. Does it mean that inertiality of a living cat is more than that of a big stone? No doubt it does. Obviously the differences between two objects under consideration consists namely in IM, because MM of a stone and cat can functionate approximately in the same way, realizing only the functions of a division border.

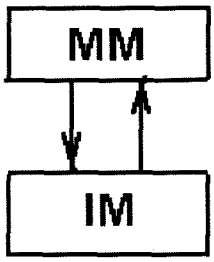

Fig.2. Memory structure of arbitrary system.

From our point of view,the inertial memory of inanimate systems have the structure, shown on fig.3. Let's call the structures of such type memory as pyramidal. Let's mark that such structures are able to be co-ordinated only with an external medium and have not a potentiality to the space-time adaptation. Under the adaptation we shall understand the ability of system to change actively the interaction parameters of its subsystems till the phenomenon of species-generation, that is to the full reorganization of its structure on the (N-1) level of subsystem.

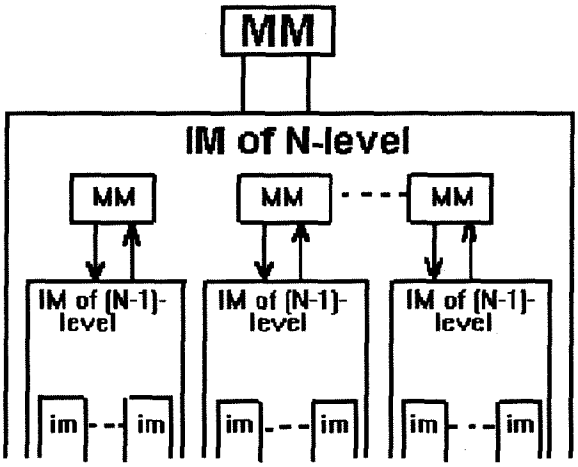

Fig.3. The pyramydal memory structure (inanimate system).

As is known, the living systems are the only of known ones, which have the adaptational properties in full measure. They are able of making actions on active adaptation to the conditions of existing in space and time by means of inherent to living system memory structure. Due to it, such organization of IM, which can serve as means of space-time adaptation of living to the surrounding medium and to make functions of taking as known as new decisions, we shall call as an intelligence. (We ask you not to confuse living systems and clever ones, in which not only IM but MM both have specific structures.) Below here we shall show that living systems have a property of self-development, during the inanimate ones are bordered only by the property of self-organization.

The memory structure of the living systems is presented on fig.4, and called as "vortical".

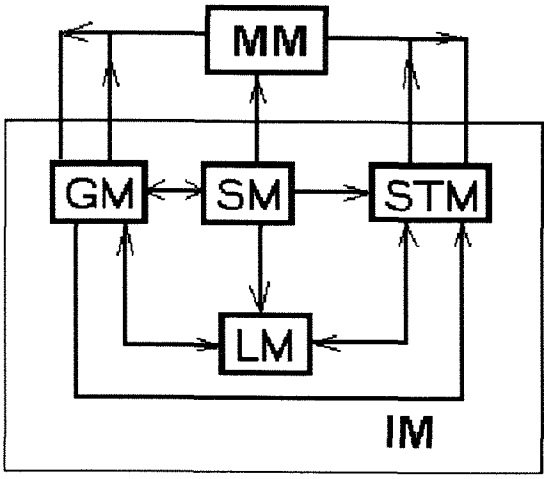

Fig.4. The memory structure of the living system (natural intelligence).
MM - momentary memory (in our case sensory memory);
STM - short-term memory;
LM - leasting memory;
GM - generic memory;
SM - species memory.

And now we'll tell in short about subsystems of the living system inertial memory.

MM - provides the adaptation to the phisics-chemistry condition of a surrounding medium and have τ equal to fractions of a seconds.

STM - provides the situational adaptation in the process of interaction with the external systems and have τ, equal to ones and tens of a second.

LM - provides the adaptation in the process of a given living system existance, and presents the life experience bank; determines the behaviour individuality.

GM - provides the lasting adaptation of a concrete straight descendant line of a given living species; determines the somatical individuality.

SM - provides practically unlimited in time adaptation by means of species phenomenon realization, which leads to the full reorganization of the living system.

From our point of view namely such memory structure of the living systems provides their phenomenal inertial properties.

So, we have considered in short the pyramidal and vortical systems, that is inanimate and intellectual (living) ones. Once again we ask you not to confuse the somatical intelligence of the living systems with the intelligence of clever living ones.

Let's turn to the artificial systems. As an example we consider the recieving part of a radiotechnical system, providing the functioning of an aircraft (RTS PF), presented on fig.5. This system has a structure, which is very close in its difficulty to the living systems. In fact, on the way of signal coming to the operator, such structures are being put into operation, which can be interpreted as MM, STM and LM. All the receiving part of RTS PF carries the generic properties of radio sets exactly and can be considered as GM. Apart from the living system the species memory is absent, and there is no full number of revers connections.

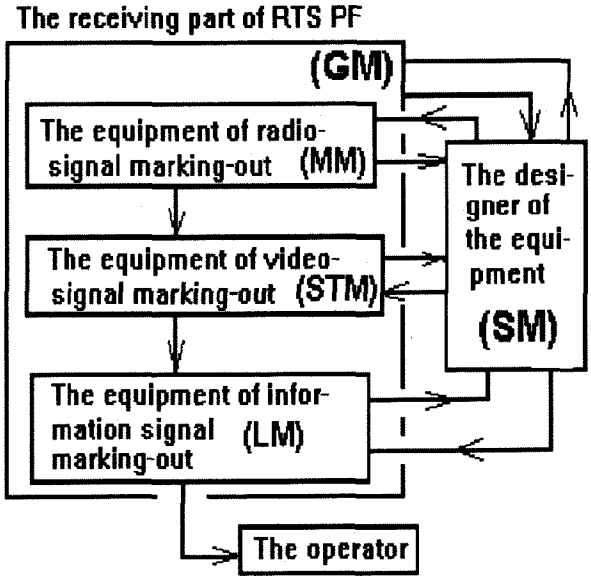

Fig.5. The receiving part of the radiotechnical system providing the functioning of an aircraft and the ways of its system-generation interactions between the subsystems.

MM, STM, LM, GM and SM - are accordingly the momentary, short-time, lasting, generic and species memories.

Hence for the perfection of radiotechnical equipment, that is for giving to the system the auto-development properties, the external organizing beginning is needed in the form of a man-designer, who, in this case, is in the role of a species system memory, and the "locker" of system generation interactions. These reasonings offered us to relate such artificial systems to the "pyramidal-vortical" type.

Needless to say, that for the simplest artificial systems, man through playing a role of external system-generation factor, is not a factor of pseudo-living system-generation, with which the operator works in the information-exchange rate (see fig.5).

We suppose, that the real intellectualization of the artificial aviation and cosmic systems lies namely on the way of living systems memory structure imitation in the corresponding apparatus complexes.In this case, the equipment will become not simply the information supplier and executor of some strict programs, given in advance, but also a partner of a man-operator when carring out the concrete tasks.

For realization of above-mentioned perspectives and the synthesis of the corresponding equipment and program products, first of all it is necessary to determine at least the general regularities of interaction between (N-1)-level systems in the process of N-level system generation.

The interaction between (N-1)-level systems in the process of N-level system generation.

In this section we shall cinsider the dynamics of generation and existing of systems in time. The reasonings presented below are the results of thinking experiments under the hypothetic medium, containing only (N-1)-level systems, which where in the condition of N-level system generation. Let's call (N-1)-level systems as the elements.

Obviously F_{mom} for the totality of some elements always can take a volume, different from the zero, but it does not yet mean that system generation is going on. The latter realizes only when inertial period τ from formula (3) will essentially exceed the volume dt from formula (2). In the other words the form-generation process, provided by the non-linear inter-element interactions, is only a condition for the system generation. One can say that information index F_{mom} "declares" the form of a new possible system. The form stabilization (when $\tau >> dt$) demonstrates the new system appearance, having power index different from the zero. However the latter still depends on the properties of that medium, in which the system-generation is going on, that is not every momentary form passes into the stable form. It's essentially to mention here, that the non-linear order of inter-element connections is not important here but such combination of information and power indices, which will allow a new system to stay in stable condition in the medium given. But it is not all yet. During the time course both medium and system parameters are changing, and at last such moment comes, when our system comes into the opposition with the existing conditions and passes into the more unstable state.

For the illustration of mentioned here let's consider fig.6, where the changing of steadiness condition of systems (S) is shown in dependence on time. We remind you that steadiness parameter is a 4-th dimension of the 4-domension systematic space, of which we have mentioned above.

For the time (t_o,t_1) when keeping between (N-1)-level subsystems to the conditions, providing the system generation, the inanimate system has time to self-organize and pass into stable condition, exceeding the level 0,5 (see fig.6, curve A). (t_1,t_2) - the period of stable system existance, until the medium condition and the inner system structure come into the opposition. The period (t_2,t_3) corresponds to the field, where at any moment there can occure a system distruction.

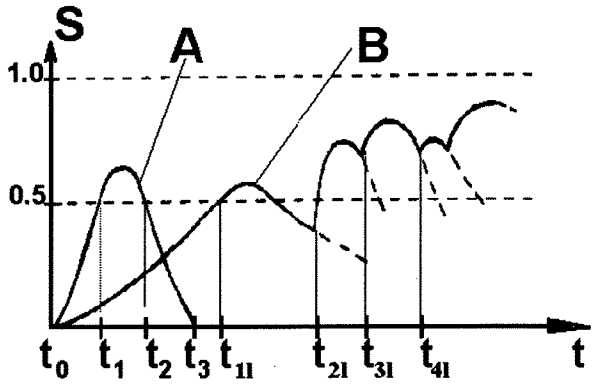

Fig.6. The dynamics of system evolution. Index "l" shows that the time note concernes the living system.
S - is the steadiness system index, which corresponds to the probability of joint functioning of united systems.
A - is inanimate system; B - is living system.

The dynamics of living systems existance demonstrates a more difficult picture (see fig.6, curve B). On (t_o,t_{1l}) interval, the living system as the inanimate one, is in the stage of system generation. Then comes the self-development period. Its typical moments are the points of singularity t_{2l},t_{3l} and analogus to them. For time t_{2l} system, being found in the unstable condition, have acquired a big freedom of connection reorganization between the subsystems and realized the species-generation phenomenon, that led to the steadiness increase of all system. At the time moments analogous to t_{3l}, the system have supported its steadiness by means of changing the

character of its subsystems interactions, getting an experience, analogous to the studying.

As long as the subjects of our special interest are the artificial systems, let's consider the most simple artificial system, presenting as the non-modulated electro-magnetic oscillation, radiating by the RTS transmitter. In the general form it presents the following:

$$U(t) = V_m Sin(\omega_o t + \varphi_o) \qquad (4)$$

One can consider U(t) as N-level system consisting of (N-1)-level subsystems, that is $I_1=V_m(t)$; $I_2=\omega_o(t)$; $I_3=\varphi_o$.

The system presented exists in the conditions of the artificially created medium, generated by the electrical scheme of a transmitter. As soon as the medium changes by means of component aging or switching off the feeding, our system passes into unstable condition and finishes its existance, that is its evolutional curve corresponds to the inanimate system (see fig.6.A).

For the increase of system functional steadiness U(t) we can make variouse changes in the scheme of a transmitter, or change cardinally the principle of its work. It means that system steadiness will begin to change according to the curve on fig.6.B, realizing the principle of the living system work by means of a man-designer interference.

So, the process of the living and inanimate system generation first of all determines by the system generation medium, and also by the properties of the elements united into system. Both the former and the latter at present are accessible when imitating the process of system generation in computer modelling.

To conclude we mark out that extra investigations and creation of the mathematical media for system studying, imitating the living systems, will offer to come to the real equipment intellectualization, actively adapting to the solution of tasks, put forward by a man.

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