# Immanent haziness of social system: mathematical description and control.

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*The hierarchical multilevel system theory is used to the social system evolution description. The development of the social system as an evolution of systems with inside non-determination is studied on the base of non-standard analysis. The evolution of social systems is represented as a movement in the space of states. "Human" states space is the reduction of full space which is happening by the filtration. The global and local optimal trajectories from point of view of mathematics are determined.*

**Key words**: system, hazy, information, control, filter, hierarchy

## *Introduction: Variables set and hierarchical hazy.*

The classical ``descriptive" approach does not satisfy the main idea of quantitative description of social systems. This approach only analyzes the past situation. But now we need another description, which can give us the prediction, the control parameters and characteristic of the critical points [1].

Nowadays, the multilevel hierarchical system theory (MHST) representation of our world is very popular [2, 3]. The schematic images of three - level hierarchical system presented on the fig.1. This representation contains the most important elements of the MHST. They are the subsystems, situated on the same level, the higher level system (sway), the control influence (solid lines), information exchange (dashed lines). Taking into account the investigated problem, the levels have the different meaning. The three level hierarchical system is interesting because in the first approximation this kind of systems can represent real multilevel system. The lower level, external for our system, acts on the higher level (on our system) and change his structure (elementary unit). The same our level 1 “accumulate” some detail of activity of whole system. But in any case the haziness is presented in the our system (the gray band on the level 1, 2) and have influence on the our level. From the point of view of the general system theory the living systems are the coordinator of a physical and a chemical systems and simultaneously are controlled by the intelligent

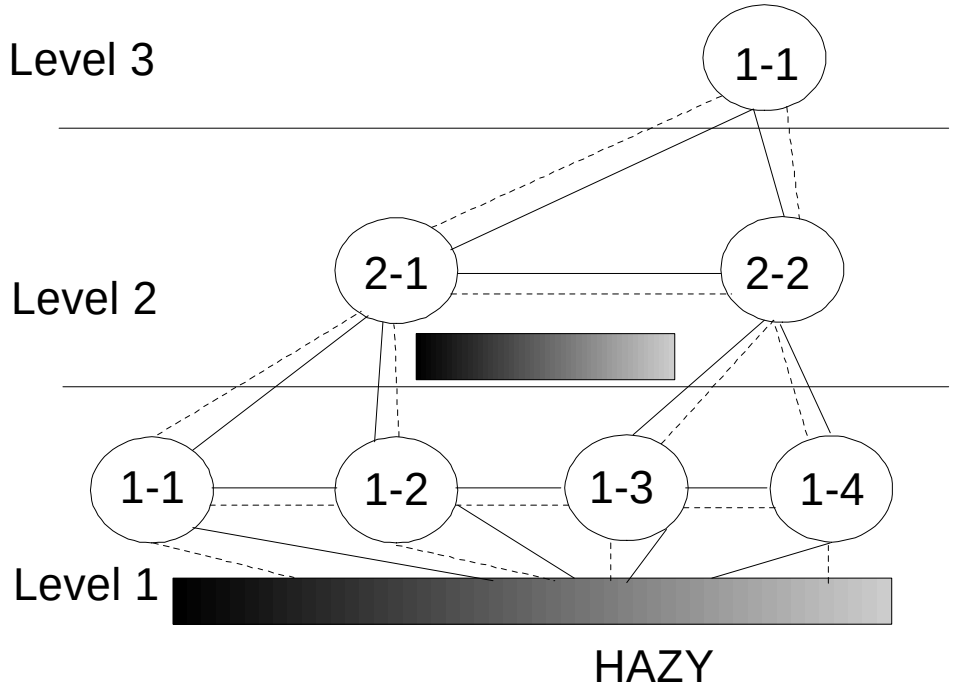


Figure 1. Representation of hierarchical systems. The transition between subsystems of one level generated by the operator of multiplication $r^*$, between subsystems of different levels generated by the operator of composition $r^+$.

systems. The intelligent systems are the systems aware of the own activity. The evolution of the system situated on any hierarchical level can be investigated as a movement along the trajectory in the specific generalized space of states [4, 5].

MHST states that the problem of social system description can be reduced to description of interactions between subsystems and levels. Though a problem so formulated is most general, it has been shown that these interactions can be adequately described from cybernetic standpoint. However, a major difference from classical cybernetics is observed in this case: It is essential to introduce *freedom of choice* for elements of the social system (SS).

As a rule most of social systems are systems with uncertainty.

**Definition: social system**

In the widen meaning under the phrase "social system" we imply the objects which are connected with the collective actions of living organism, objects, which do not exist out of borders of the activity of the collective. •

Our aim is researching more narrow social systems and systems connected with the activity of the human society.

Social systems which are connected with acts of human form only the part of possible social systems, but the complicates one. The main difficulties of forecasting and creation the adequate models of social systems connected with the acts of people are raised by the next:

A.) This social systems are systems with uncertainty because the units of social systems (people) have mind and freedom of will.

B.) Systems are non-determined and the onset of chaos regimes or regimes of self-organization in them is possible.

Our interpretation of the social system is rather simple but it helps to widen all the diversity of manifestation the activity of the living organism - from self-organization of structures in communities of microorganisms to chaos processes in economics. By the mathematical point of view each system which satisfies the determination of social system generates the specific generalized space of states [6]. This full space is denoted $A^N$. We believe that this space is continuous because the set of attitude is full in the closed region of possible meaning. Mapping the space $A^N$ on the space which corresponds the description of "human" social system is the limited space $H^n$ which appears by the filtration in mean of non-standard analysis [7].

The presence of such "freedom of choice" is equivalent to the presence of indeterminate behavior within the system, or *hierarchical haze* in the system description. Likewise objects have been intensively researched in all branches of science lately. Physics regards *dynamic systems* (DS), that is, systems whose state depends on time, to be an instance of such objects. In general case SS is not equal to DS. In first approximation the primitive tribe in the stable natural condition has the stable existence and can be interpreted as a non-dynamical SS because the averaging characteristics of the society have any dynamics in really observed time. (The good example at present is the small tribe in Amazon's river basin). But in global this tribe is the SS with slowly dynamics. The contacts with external systems can change dynamic of SS evolution.

Our deliberate activity on this model is thought to consist in a series of logical operations directed to choose an appropriate state function and transition functions in SS regarded as DS. The number of such operations is, in principle, infinite provided we admit of the existence of free will. We suppose that indeterminate dynamics of an SS resulting from free choice of state and transition functions can be described in terms of a DS theory with nonstandard time. Such structured are mathematically considered using nonstandard analysis. So, choice in SS is viewed as "standardization procedure" for corresponding DS objects.

There is a term regarded as a key factor by nonstandard analysis, called a *monad* [8]. Besides, any finite number, being an SS characteristic, has a corresponding part of the monad located at the point *R* on the number axis. Phase space can be introduced in a DS, where a phase point mirrors each element (state) of the system. In this case indetermination of an SS is characterized as a *halo* $h(G)$, that is, we have an area of possible states for a system instead of a completely deterministic description. This corresponds to the impossibility of sociological parameters to be determined exactly, with one exception for those exact by nature, like, say, the exact number of voters.

Any SS is both a *sway* for its subservient system and a subservient system for its own sway. As an SS situated on a certain level evolves, it attempts to gain knowledge of the laws of its sway and "to hide in the hierarchical haze" its influence on the levels that normally control it. Meanwhile, any interaction between systems includes exchange of partial information about the structure and functioning of the interacting systems. If this information increases the system's "understanding", the hierarchical haze diminishes and the system thus grows more competent. If, in turn, the competence increases sufficiently, the system can increase its rank and move to a new structural level.

In terms of the above mentioned concepts, the social structure of countries with democratic structures, transparent legislation and determined boundaries for all sub-

structures' activities is intuitively understood to function more efficiently. Mathematically speaking, the halo of the model occupies a smaller area in the phase space, so the phase volume of the hierarchical haze is small in this case, too.

The social systems strive to correct its evolution to obtain the optimal evolution trajectory because they have enough information about the sway activity. This amendments are made basing as on the main information, which presents in the system, so on the base of the anticipatory information. In the formalism of hierarchical mathematics [8] the prognostication is possible in case the system situated on the hierarchical level ë receives the information (knowledge) about the level â, where â is the arising time (level). The classical example of system with the corrections and the anticipations is the business corporation. Without the activity of managers (sway for the system) the corporation can't have a success. The effectively of the corporation depends on the successful anticipating.

The reception of such information relatively to any level is possible because any system contains the hierarchical hazy in its own structure [9, 10]. This hierarchical hazy is closely connected with the indeterminacy of social system. Any system which is situated on any level translates its image to the hierarchical hazy too and his corresponding interpretation (the reception of the mathematical expression) causes the collapse of the hazy and induces the representation of knowledge.

### *II. Space of states and hierarchical hazy.*

The main task in mathematical description DS at present moment is choosing the corresponding space of states for the concrete systems. This choosing is limited by the set of actual determining hierarchical variables. The full set of hierarchical variables is well known [9, 10] but the transition to concrete system demands the definition of the filter (in meaning of non-standard analysis). This filter must cut the subspace of realization of present system from the generalized hierarchical space. It is possible to write this filter as [10]

$$H^n = A^N / \aleph,$$

where $H^n$ is the limited space, connected with the activity of studied system, $A^N$ is the full space of states for social system on the present level, $\aleph$ is the filter of transformation degree *(N-n)*. The exact structure of $\aleph$ depends on our understanding the distinguishing differences between concrete systems and unit elements of present level. In such case the social system is determined not only by the set of variables but by the corresponding filter, too. The halo of the unit structure on the present level is organized because the homogeneous system (as an example, the corporation) is situated simultaneously on the same level but have different structure and sway (figure 2). There gray disks are represent the corporation image in the phase space and intersection (black) ge-

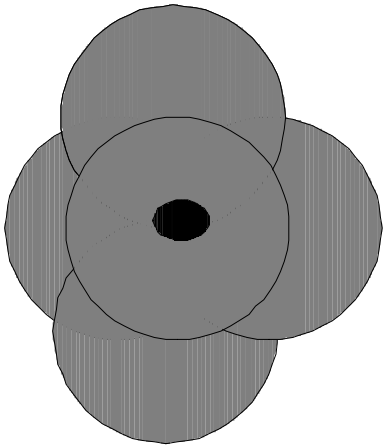

Figure2. Origin of halo in SS.

nerated the monad (the exact value) of corporation characteristics. The monad can be interpreted as a common elements of different corporations structures. The success or un-success of corporation activity depend on the system sway tactics. Difference of tactics is realized through halo because the different firms has a distinguishes halo.

**Definition**: **exception filter**

In the case $N=n$ the filter $\aleph$ is the exception filter. This filter cuts down from the full set of the variables only the characteristics of the Homo.•

The process of optimization of SS development must be realized on all hierarchical level, as an example in the culture, in the social systems, on the level of chemical and physical processes because the filtration is acting on the different structure levels. For example, the principle of maximum effectively of investment can be taken as a filter, which optimizes all the acts and the system development on the business sublevel. But this filter is not applicable for the culture, because this filter cuts only some important variables from $A^N$ and we receive $H^n_{business} = H^n_{culture}$. It is a mistake because a lot of variables are not actualized and power of haziness for the space $H^n_{culture}$ is very high and system is undetermined. The choice of the filter depends on the sway for any hierarchical system. In the simplest case of two-levels system appearing of the registrar (it is the simplest variant of coordinator) corresponds with the knowledge creation. The knowledge creation differs from the information reception and can be compared with an elementary act of self-organization [10].

### *III. Some mathematical background*

Let's investigate the interaction and influence of two business systems or business and other social organizations situated simultaneously on the same level. This interaction can be realized only through sway level. For this social systems the sway is acting on the knowledge level [2, 3, 5, 9].

Let's introduce the coefficient of receptivity of the sway influence

$$\frac{1}{\Re} = \frac{I_s}{I_a}, \qquad (1)$$

$I_s$ is the amount of control information production of the sway, $I_a$ is the amount of information accepted by system. Under other equal condition let

$$\lim_{l \to \mathrm{B}} I_s = const = I_s^0, \tag{2}$$

but the $I_a$ is the essential non-constant,

$$I_a = I_a(VED). \tag{3}$$

*VED* is the assembly of averaging data which characterised the person belonging to the social system.

The full *VED* set of variables depends on sorts of social system. All elements are interacting according to the law. As we note the main problem is the correct choosing the space of states. The basis vectors of this space must be the main conditions which characterise studied social groups. The full description of the set of variables is the object of next research.

The general task of the sway control is

$$\lim_{l \to \mathrm{B}} \Re = \max. \tag{4}$$

Taking into account expression (1, 2) this gives

$$\lim_{l \to \mathrm{B}} I_a = \max. \tag{7}$$

According to [5,9] the total process of interaction between business systems and social systems through knowledge level has the form

$$\Pi \leftrightarrow {}^{+}r^{\,l} \oplus {}^{\times}r^{\,l}, \tag{8}$$

${}^{\times}r^{\,l}$ is the multiplying act of original state, ${}^{+}r^{\,l}$ is the uniting act of connection of the ordinary units and creation of the new sway, $\oplus$ is the symbol of operation between two acts. With (1, 2, 8) for the full coefficient of receptivity we will obtain

$$\left(\frac{1}{\Re}\right)^{\oplus} = \sum_{\substack{j,k=1 \\ j \neq k}}^{i} \left(\frac{1}{\Re}\right)_j \oplus \left(\frac{1}{\Re}\right)_k = \sum_{\substack{j,k=1 \\ j \neq k}}^{i} \frac{I_{sj}^0}{I_{aj}} \oplus \frac{I_{sk}^0}{I_{ak}}. \tag{9}$$

Equation (9) written in generalised case when *i* systems are situated on the same level. The optimal strategy of the knowledge management available from equations (7), (9). This management would be realised by the controlling of the $\Re$ value.

### *V. Conclusion: Variables set and hierarchical hazy.*

The hierarchical hazy is out of the boundary of structure of system (Symbol ? in equation of hierarchical mathematics [2, 3, 8]). We can not know the exact law of the hazy, but only some influence of this higher strata to our lower strata can be studied. But hazy problem is important only for some of known social systems. As an example,

at this moment we do not have full set of variables and the law of the ethnos. In this case the ethnos as object belongs to the relatively higher strata, i.e. to hierarchical hazy and we understand only some of its aspects. As the system of the highest strata ethnos also includes genetic, social, and business substrata and it is the co-ordinator (sway) of this strata. The whole ethnos is the complex system, which includes all lower strata (all pyramid) but have more general characteristics. Because the existence of the sway depends on the existence of the lower strata that is why hierarchical hazy is condensed near the breaking point of the evolution lower strata. (The sociological example is the war that is accenting the national spirit).

The full "hierarchical portrait" for the most part of the other systems now can be received. Thus influence and direction of development can be optimised. In our changeable world only correct understanding of the main principles of system evolution allows to win in the development and rivalry.

The determination of full set of the variables and the mathematical expression of actual system and coordinator could help to create the base for the mathematical representation of higher strata of hierarchical model of the world. The actuality of the biological level studies is connected with direct link between the consciousness processes and the R. Feynman's reversible quantum mechanical computer functioning [10]. Evolution of biological systems in such approach turns out to be an evolution of registers and programs contained in living substances.

The received result could make clearer the determinacy – indeterminacy transition rules for the living and social systems. Besides this the set and the structure of actual variables of the living and social systems can be determined. The collection of received variables could help to build the filter corresponding level for the full space of states.


### *Acknowledgement*

I am specially grateful to my colleague prof. S. Novikava and prof. V. Barkaline from the Institute of Mathematics and Cybernetics for discussions on this theme and P. Buka for a plenty important correction.


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