Universe as Self-Organizational System

Mikhail Ignatyev
St-Petersburg State University of Aerospace Instrumentation
E-mail: kira@robotek.ru, ignatmb@mail.ru

Abstract
Today in astronomy and astrophysics we have a lot of facts, which need the new explanation. On another side we have the new scientific directions – cybernetics, system analysis, synergetics and informatics, which used for study of complex systems in biology, economics and technics, and naturally to try to consider Universe how complex system and to use the accumulated arsenal of instruments of investigation of self-organizational system. This report is the attempt in this direction. We examine the linguo-combinatorial simulation of solar system, where used how key words the names of planets, and detect the structural uncertainty in equivalent equations systems, which can used for adaptation in flow of changes. The constructed self-organized system is the basic building block, which can create collective on different levels – planetary, galactic, etc. Star clusters are the basic blocks for creation of equivalent equations with structural uncertainty, which can use for stabilization of systems.
Today the understanding of asteroid hazard for mankind is confirmed by means of big amount of experimental facts and theoretical simulation results. The size of asteroids increase the degree of danger, it is obviously impossibility of catastrophe for big asteroids if we will be stay on old scientific paradigm. In this paper we try to search the way from dangerous situation on basement of linguo-combinatorial simulation of complex planet systems.
If we shall take the key words – Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto – 10 variables, we shall have the equivalent equations with 45 arbitrary coefficients. In this equations system A1 – characteristics of Sun, E1 – variation of this characteristics, A2 – characteristics of Mercury, E2 – variation of this characteristics, …, U1, U2,…,U45 – arbitrary coefficients, which permit to control of characteristics. The discovery of this new possibility is very important for mankind in view of asteroids hazard. Big hope is the discovery of new methods for planet processes control. For stability the sun system must be in the adaptation maximum zone.
Keywords: universe, system, self-organization, astronomy, astrophysics.

1 Linguo-Combinatorial Simulation

Frequently we use the natural language to describe systems. We propose to transfer this natural language description to mathematical equations.

For example, we have a sentence

WORD1 + WORD2 + WORD3 (1)

where we assign words and only imply meaning of words, the meaning (sense) is ordinary implied but not designated.

We propose to assign meaning in the following form

(WORD1).(SENSE1) + (WORD2).(SENSE2) + (WORD3).(SENSE3) =0 (2)

This equation (2) can be represented in the following form

A1.E1 + A2.E2 + A3.E3 = 0 (3)

where Ai, i = 1, 2, 3, will denote words from English Appearance and Ei will denote senses from English Essence. The equations (2) and (3) are the model of the sentence (1). This model is an algebraic ring and we can resolve this equation with respect to the appearances Ai or the essences Ei [4,5,6]:

A1 = U1.E2 + U2.E3

A2 = – U1.E1 + U3.E3 (4)

A3 = – U2.E1 – U3.E2

where U1, U2, U3 are arbitrary coefficients, can be used for solution of different tasks on the initial manifold (2) or (3). In general if we have n variables in our system and m manifolds, restrictions, then the number of arbitrary coefficients S will be defined as the number of combinations from n to m+1 [4], as shown in Table 1,

$$\mathbf{S} = C_n^{m+1},\ n > m \qquad (5)$$

Table 1. The number of arbitrary coefficients depending on the number of variables n and the number of restriction m.

n /m	1	2	3	4	5	6	7	8
2	1							
3	3	1						
4	6	4	1					
5	10	10	5	1				
6	15	20	15	6	1			
7	21	35	35	21	7	1		
8	28	56	70	56	28	8	1	
9	36	84	126	126	84	36	9	1

The formula (5) is the basic law of cybernetics, informatics and synergetics for complex systems. The number of arbitrary coefficients is the measure of uncertainty. The formula (2) and (3) is the result of polarization.

2 Adaptation Possibilities of Complex Systems

Usually, when solving mathematical systems, the number of variables is equal to the number of equations. In practice we frequently do not know how many constraints there are on our variables. Combinatorial simulation makes it possible to simulate and study the systems with uncertainty on the base of incomplete information. The problem of simulation of condition, guaranteeing the existence of maximum adaptability is investigated.

It is supposed that the behavior of a system with n variables is given with an accuracy of m intersecting manifolds, n > m. If the system is considered as a multidimensional generator (Fig.1) where at least a part of the variables interact with environment variables, and if the objective of the system is to decrease the functional of discoordination between them ($\Delta 1 \ldots \Delta k$), the system control unit has two instruments of impact, a and b, upon the system. First, this is the tuning – the changing of uncertain coefficients in the structure of the differential equations of the system, taking account that the greater number of these coefficients implies more accurate system response to changing environment. Second, this is the learning – the imposing new restrictions on the system behavior. The number of arbitrary coefficients, in the structure of equivalent equations, changes in the process of learning, of consecutive imposing new and new restrictions on the system behavior. In the systems with more than six variables the number of arbitrary coefficients increases first, and then, passing through the maximum begins to decrease. This phenomenon makes it possible to explain the processes of system growth, complication and death. The existence of maximum adaptability phenomenon is observed in and proved by numerous biological, economical and physical-engineering systems.

Fig. 1 shows the interaction between system and environment. It is important that we describe a system with a full sum of combinations and have all the variants of decisions. The linguo-combinatorial simulation is a useful heuristic approach for investigation of complex, poorly formalized systems.

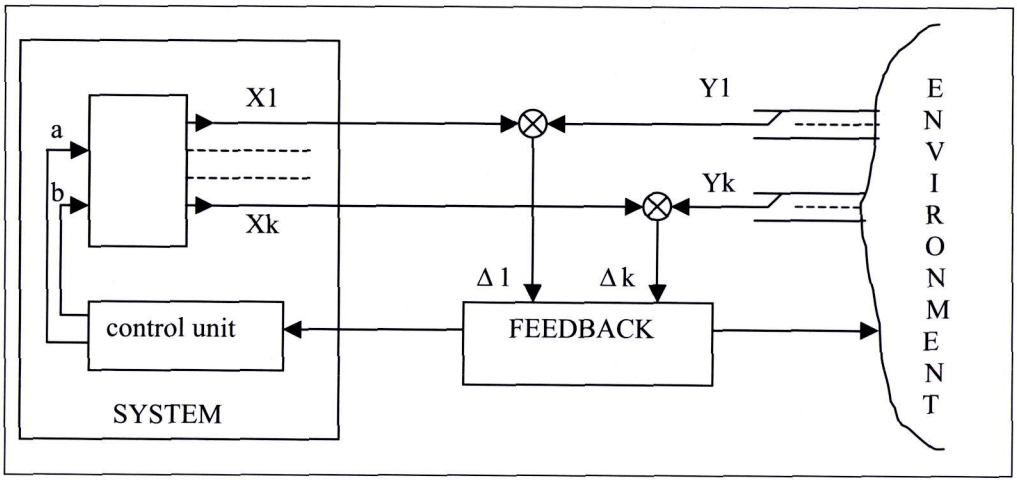

Figure 1. Model of "System - Environment".

Natural language is the main intellectual product of mankind; the structure of natural language reflects the structure of natural intellect of mankind and its separate representatives on the level of consciousness and unconscious. Linguo-combinatorial simulation is the calculation, which permits to extract the senses from texts.

Wittgenstein wanted to have the calculation of senses . In our calculation we have the three groups of variables: the first group – the words of natural language Ai, the second group – the essences Ei, which can be the internal language of brain [11]; we can have the different natural languages, but we have only one internal language of brain; this hypothesis opens a new way for experimental investigation; the third group of variables – the arbitrary coefficients, uncertainty in our model, which we can use for adaptation in translation processes and etc.

The equivalent equations of any system contain arbitrary coefficients, which can be used for controlling it. The control may be internal or external. The behavior of any system with an environment contact will be determined by means of formula (5), which is the main law of cybernetics. Each organism has a maximum adaptability zone.

The sustainable development of systems can be only within maximum adaptability zone. The sustainable thermonuclear reaction is possible only within this zone. For retaining the system within maximum adaptability zone, we have the different instruments – increasing the variables number, imposing new restrictions or removing the old ones etc. For example, we can joint different systems in an integral system to increase or decrease the adaptability of systems. So, from the two following systems

$$S1 = C_{n1}^{m1+1} \quad \text{and} \quad S2 = C_{n2}^{m2+1} \tag{6ab}$$

we can joint them in imposing new restrictions, mcol, in view of obtaining the new collective system

$$Scol = C_{n1+n2}^{m1+m2+mcol} \tag{6c}$$

where the adaptability of this new system can be either Scol > S1 + S2 or Scol < S1+ S2 depending upon concrete parameters. We can only see the collective, total effect.

3 Self-Organization and External Control

A lot systems are the self-organizational systems and it's structure contents the internal control block or hierarchical control system, for example, biological systems. But genetic information matrix is the external control message. During live cycle of man we have a lot of actions of different types – from education system, from mass-media and etc.

As a result of the many different forms of transport systems being used in the world today– cars, ships, train, aircrafts etc., the number of different types of potentially damaging and extremely hazardous situations are increasing exponentially [16]. After the September 11th incident, it is clear that the old safety conceptions and procedures previously utilized are no longer valid in the present world situation, in which thousands of men and women are ready to sacrifice their own lives for political and religious purposes. Utilization of previous safety measures and procedures only serve to perpetuate the fear of death in many societies around the globe. Therefore, it is necessary to create a new safety environment, which must be sustainable [4] through the development of new safety concepts and procedures. In this article, we are considering only one aspect of this very serious problem – the challenge of introducing external control(s) for aviation systems in extreme situations.

Since today's existing transport systems have internal controls across the board for pilots, drivers, and captains, terrorists are able to usurp internal controls and use the transport systems as weapons in spite of a variety of existing and prospective legislative safety measures [5].

Today, the potential exists for interrupting internal controls and introducing external controls and measures through the use of an onboard computer network. Several complex challenges must be resolved in order to utilize external controls and procedures. The first question is – why do we not see the wide use of automatic procedures in transport systems? A person can be a pilot, driver or captain. The answer is – the transport situations are very complex and therefore, it is necessary to use a person's high adaptability and potential for decision making as related to transport control problems [6,7].

In potential problems we can observe two parts – one part is the transport system, which is constantly evolving. The other part is the transport environment, with the potential for very rapid change. The transportation community exerts tremendous efforts in an attempt to organize the transport environment – to create the necessary roads, airports, trail way stations, seaports etc. However, existing procedures are not sufficient for utilizing automatic systems with low adaptation possibilities [8,9]. Upon development of a highly organized transportation environment, the complexity of transportation device controls can be decreased, and to the contrary, if an ineffective organizational transportation environment exists, very complex transportation device control systems will be required. Hence, it is necessary to use the hybrid intellect approach to study this complex problem.

In this proposed project, we prefer to use the term «external controls» instead of «remote controls», which is narrow and technical.

In order to achieve effective External Controls, it will be necessary to resolve many technical and organizational problems together within the US and Russian aircraft and transportation organizations. To this end, it is necessary to create the theoretical basement, as outlined below in the technical portion of this presentation.

3.1 Purpose of EXTERNAL CONTROL

In transport systems, several levels of safety exist. In a "normal" situation we have the good level of safety LS1. After a terrorist act a low level of safety LS2 will exist. After inserting an external control we must have to increase the level of safety LS3. The purpose of our investigation is the evaluation of safety levels in transportation systems and the development of algorithms to increase the level of safety. Therefore, we must have: LS1 > LS3 > LS2

The safety level is determined by the adaptation possibility of our transport system, which consists of transport device (aircraft) and transport environment. The structure of transport environment includes the transport infrastructure (road, airport etc) and the external transport control – off line control and online control in extreme situations; we must have the online control. Basement of transport control system is navigation systems of different types and systems of restrictions for movement. The structure of

transport device includes its own transport devices (car, aircraft, train, ship etc) and control systems, which include the internal control system – usually online and external control system – offline and online. For identification of extreme situations we can use the signals from our transport devices and the results of the observations of transport devices behavior; when our transport device decline from normal behavior, we have the extreme situation. Here are some examples:

- Investigation and evaluation of logical- dynamic model of transport devices (aircraft) are necessary for decision-making support for inserting an external control. Each concrete aircraft is a complex system and has its own features, which is very important for an external control. We must use the full sum of dynamical systems identification methods for the decision making of this task [10,11].
- Petri Nets based simulation and formal analysis of systems. Its novelty consists on mathematical method of net's properties analysis that allows diagnosing of different objects.
- Displaying and processing of information based on the complexity of different kind of information and hyper-connecting.
- Structure-linguistic processing of geometrical and graphical information based on the linguistic object model concept. Object structure description language and its formal grammar are to be designed. It allows integration of computer graphics, geometrical simulation and image analysis systems to a unified model, to decrease the calculation time spend by converting digital processing to symbolic one [12,13].
- The methods, software tools and demonstration prototypes of intelligent on-board informational-control computer systems and application systems based on those tools for implementation of tasks for checking and diagnosing, pilot interface, estimation of air-force situation, fly planning, etc.
- Expert system prototype for checking and diagnosing on-board equipment.
- Software tools and expert system prototypes for the estimation of n-times equipment fail influence on various modes of its operation.
- Tools for automatic knowledge base building for situations analysis.
- Multi agent system theory for the investigation of virtual worlds in transportation and how multi user system can be used.
- Hybrid intellect possibilities (man + computer network). We prefer to use the term «hybrid intellect» instead of «artificial intellect», which is narrow and not suitable for cooperation between man and computer networks. It is necessary to use the multi agent system for control of transport. Each transport device must have its own agent, which has the full information about this device. It is necessary not only for the defense from terrorists but for the good organization of transport flows. It is necessary for the increase of economical effectiveness and for organization of inter modal transport systems.
- Different places in the world have different organizational levels of transport environment; to organize the external control for defense against terrorism, it is suitable to begin from places where we have a high level of transport infrastructure. Realization of external controls for transportation systems in extreme situations is possible only through across the board international cooperation.

4 Structure of Planet Systems

Today we have a lot of new problems about structure of Universe. It is obviously, that only 5% of Universe is the visible, another – dark matter and dark energy and etc. It is the good stimulation for search of new models,

Firstly we determinate the atom structure by means of linguo-combinatorial method on the basement of key concept of science. For example, if we have hydrogen atom with key words, Atom + Proton + Electron, then we shall have the equivalent equations:

$$E1 = U1.A2 + U2.A3$$

$$E2 = -U1.A1 + U3.A3$$

$$E3 = -U2.A1 - U3.A2 \qquad (7)$$

In this equivalent equations –
A1 – characteristic of hydrogen atom, E1 – variation of this characteristic,
A2 – characteristic of proton, E2 – variation of this characteristic,
A3 – characteristic of electron, E3 – variation of this characteristic,
U1, U2, U3 – the arbitrary coefficients, which can be wave functions.

For simulation of deuterium we can use the key words, Atom + proton + electron + neutron, after operation of polarization we shall have

$$A^1_1.E1 + A^1_2.E2 + A^1_3.E3 + A^1_4.E4 = 0 \qquad (8)$$

and equivalent equations will be

$$E1 = U1.A^1_2 + U2.A^1_3 + U3.A^1_4$$

$$E2 = -U1.A^1_1 + U4.A^1_3 + U5.A^1_4$$

$$E3 = -U2.A^1_1 - U4.A^1_2 + U6.A^1_4$$

$$E4 = -U3.A^1_1 - U5.A^1_2 - U6.A^1_3 \qquad (9)$$

where U1, U2, U3, U4, U5, U6 – arbitrary coefficients,
A^1_1 – characteristic of deuterium atom, E1 – variation of this characteristic,
A^1_2 – characteristic of proton of deuterium atom, E2 – variation of this characteristic,
A^1_3 – characteristic of electron of deuterium atom, E3 – variation of this characteristic;
A^1_4 – characteristic of neutron of deuterium atom; E4 – variation of this characteristic.

In case of atomic reactions, conversion of deuterium to hydrogen is possible by means of transformation the equations (9) to equations (7).

After superposition of the new restriction on variables of the system

$$A^2_1.E1 + A^2_2.E2 + A^2_3.E3 + A^2_4.E4 = 0$$

we will have

$$E1 = U1.D^1_{23} + U2.D^1_{24} + U3.D^1_{34}$$

$$E2 = -U1.D^2_{13} - U2.D^2_{14} + U4.D^2_{34}$$

$$E3 = U1.D^3_{12} - U3.D^3_{14} - U4.D^3_{24}$$

$$E4 = U2.D^4_{12} + U3.D^4_{13} + U4.D^4_{23}$$

where $D^1_{23} = A^1_2.A^2_3 - A^1_3.A^2_2$, etc.

In the same way it is possible to build the linguo–combinatorial models of all the elements of Mendeleev table and its isotopes and the new elements. It is the models with control blocks.

If we would like to simulate our planet system, we can use as key words, Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto – 10 variables, and we will have the equivalent equations with 45 arbitrary coefficients. The discovery of this new possibility is very important for mankind in view of asteroids hazard. Big hope is the discovery of new methods for planet processes control. For stability the sun system must be in the adaptation maximum zone.

Today the understanding of asteroid hazard for mankind is confirmed by means of big amount of experimental facts and theoretical simulation results. The size of asteroids increase the degree of danger, it is obviously impossibility of catastrophe for big asteroids if we will be stay on old scientific paradigm [1,2]. In this paper I try to search the way from dangerous situation on basement of linguo-combinatorial simulation of complex planet systems [3, 4, 5, 6].

In system, it is very important to have centers of activity. In our planet system the main center of activity is Sun. We have a lot of observations of Sun from Siberia Sun Radiotelescope (Badari)[9]. For interpretation of these observations it is possible to use our model. It is necessary to analyze our model. Firstly, Sun system exists in flow of cosmos influences and the stability of this system is determined of his adaptation possibilities, which determine the number of arbitrary coefficients. Formula can explain the cycles of development of planet and galactic systems. Secondly, there are direct and inverse tasks. The inverse task has a lot of variant of decision. Linguo-combinatorial simulation permits to create a lot of variants of decision.

These ideas have association with the Tziolkovskij ideas, for which the year 2007 corresponds to 150 years after birthday of this famous scientist.

5 Hierarchical Control System of Universe

We had created the model of planet system and determined the instruments for control of this system by means of arbitrary coefficients manipulation, by means of restrictions covering, by means of collective organization and etc.

That is it the block of control?

Today we have the big experience about computer for complex systems control, therefore we can presuppose, that planet control block – the big computer with large memory. This memory can store a lot of scenarios of systems development. We can presuppose the hierarchical system of the same control computers. Therefore our Universe is the model inside a big supercomputer. The appearance of this hypothesis is evidently in our computer age.

In the 18th century, the main machine was watch and Universe had as the big watch, then was born the mechanism.

In our time the main machine is the computer and contemporary direction is the computation.

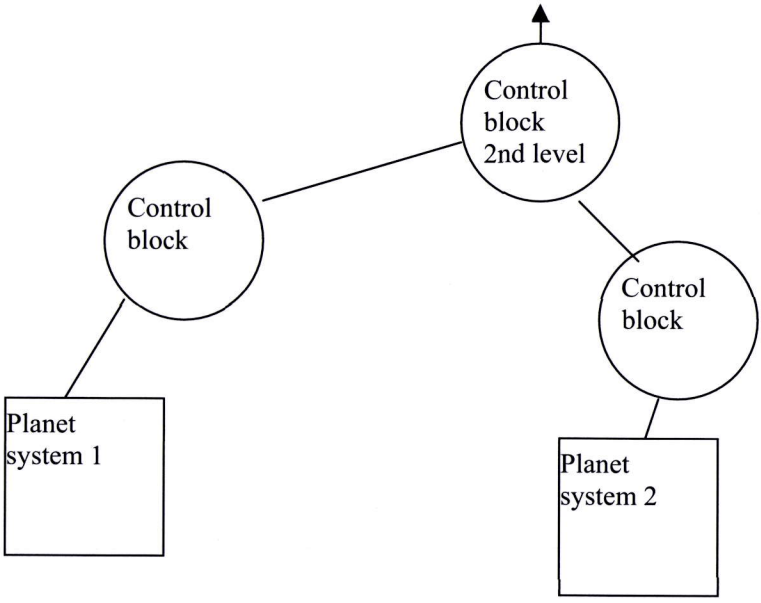

Figure 2. Hypothetical hierarchical system of external control of planet systems

6 Anticipatory and Universe Structure

When we created the computer, we created the anticipatory system. This assertion has two senses.

Firstly, if we have the mathematical or computer model, we can realize the advanced analysis of different variants of behavior of our system and by means of computer simulation to anticipate their behavior. We have a lot of same works in the different areas.

Secondly, we can presuppose that Universe is the Big Supercomputer with the different processors and memories, which store a lot of variants of different scenarios of different events.

In this case we can presuppose that the anticipation is the hacker wrench of memory and the information extraction.

May be man has this possibility, for example, Nostradamus. For development of this point of view, we must investigate the possibility of simulation systems and the structure of Universe.

Time is arriving for the deciding experiment, which can confirm or not the hypothesis about our Universe is the model in Supercomputer.

7 Asteroid Hazard Prevention Problem Analysis

Today, in astronomy and astrophysics we have a lot of facts, which need the new explanation. On another side we have the new scientific directions – cybernetics, system analysis, synergetics and informatics, which used for study of complex systems in biology, economics and technics, and naturally to try to consider Universe how complex system and to use the accumulated arsenal of instruments of investigation of self-organizational system. This report is the attempt in this direction. We examine the linguo-combinatorial simulation of solar system, where used how key words the names of planets, and detect the structural uncertainty in equivalent equations systems, which can used for adaptation in flow of changes. The constructed self-organized system is the basic building block, which can create collective on different levels – planetary, galactics etc. Star clasters are the basic blocks for creation of equivalent equations with structural uncertainty, which can use for stabilization of systems.

Today the understanding of asteroid hazard for mankind is confirmed by means of big amount of experimental facts and theoretical simulation results. The size of asteroids increase the degree of danger, it is obviously impossibility of catastrophe for big asteroids if we will be stay on old scientific paradigm. In this paper we try to search the way from dangerous situation on basement of linguo-combinatorial simulation of complex planet systems .

If we shall take the key words – Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto – 10 variables, we shall have the equivalent equations with 45 arbitrary coefficients.

E1=U1.A2 +U2.A3 +U3.A4 +U4.A5 +U5.A6 +U6.A7 +U7.A8 +U8.A9 +U9.A10

E2=–U1.A1+U10.A3+U11.A4+U12.A5+U13.A6+U14.A7+U15.A8+U16.A9+U17.A10

E3=–U2.A1–U10.A2+U18.A4+U19.A5+U20.A6+U21.A7+U22.A8+U23.A9+U24.A10

E4=–U3.A1–U11.A2–U18.A3+U25.A5+U26.A6+U27.A7+U28.A8+U29.A9+U30.A10

E5=–U4.A1–U12.A2–U19.A3–U25.A4+U31.A6+U32.A7+U33.A8+U34.A9+U35.A10

E6=–U5.A1–U13.A2–U20.A3–U26.A4–U31.A5+U36.A7+U37.A8+U38.A9+U39.A10

E7=–U6.A1–U14.A2–U21.A3–U27.A4–U32.A5–U36.A6+U40.A8+U41.A9+U42.A10

E8=–U7.A1–U15.A2–U22.A3–U28.A4–U33.A5–U37.A6–U40.A7+U43.A9+U44.A10

E9=–U8.A1–U16.A2–U23.A3–U29.A4–U34.A5–U38.A6–U41.A7–U43.A8+U45.A10

E10=–U9.A1–U17.A2–U24.A3–U30.A4–U35.A5–U39.A6–U42.A7–U44.A8–U45.A9 (10)

In this equations system,

A1 – characteristics of Sun, E1 – variation of this characteristic,

A2 – characteristics of Mercury, E2 – variation of this characteristics, …,

U1, U2, …, U45 – arbitrary coefficients, which permit to control of characteristics.

The discovery of this new possibility is very important for mankind in view of asteroids hazard. Big hope is the discovery of new methods for planet processes control. For stability the sun system must be in the adaptation maximum zone.

8 Conclusion

Linguo-combinatorial simulation permits to create the new picture of world, which has on basement the contemporary achievements of science. This approach permits to disclose the new structure in Universe and create the new hypothesis. It is necessary to investigate the control structure in different parts of Universe. Linguo-combinatorial world picture consist on three group of variables – firstly – the appearances, secondly – the essences, thirdly – the structural uncertainty, all systems (alive and non-alive) have this structure. Linguo-combinatorial simulation is the mathematical instrument of post-non-classical science. On level of non-classical science, was introduce the observer, on level of post-non-classical science was introduce the control block. Today we have a lot of tasks about investigation of Universe as Self-Organizational system..

Reference

1. E.Schroedinger "Space-time structure of Universe" Wien, 1961.
2. I.S. Schklovskij " Universe, Live, Mind" Moscow, 1986
3.M.B.Ignatyev "Golonomical automatic systems",monograph,Moscow -Leningrad, 1963, 204 p.
4. M.Ignatyev "The study of the adaptation phenomenon in complex systems" AIP Conference Proceedings, Melville, New York, 2006, vol. 839, p.322-330.
5. M.B.Ignatyev "Information systems in micro-, nano- and optoelectronics", monograph, St-Petersburg, 2008, 200 p.
6.. M.B.Ignatyev "Asteroid Hazard Prevention Problem Analysis" Proceedings of the International Conference of Asteroids Hazard – 2009, St-Petersburg, 2009.
7. M.B.Ignatyev "Universe as self-organizational system" Abstracts of The Astrometrical Conference "Pulkovo-2009", 15-19 July 2009, St-Petersburg, p.19-20.
8. Ignatiev M.B., Kulakov F.M., Pokrovskij A.M. (1972) "Robots-manipulators control algorithms", first edition-1972, second edition in USA – 1973, third edition-1977, Leningrad, 248 p.
9. Ignatyev M.B., Putilov V.A., Smolkov G.J.(1986) " Models and systems for control of complex experimental investigations" Moscow, monograph, 325 p.
10. Ignatiev.M.B. (1993)."Simulation of Adaptational Maximim Phenomenon in Developing Systems" Proceedings of The SIMTEC'93 - 1993 International Simulation Technology Conference, San Francisco, USA.
11. Ignatyev M.B., D.M.Makina, N.N.Petrischev, I.V.Poliakov, E.V.Ulrich, A.V. Gubin (2000) "Global model of organism for decision making support" Proceedings of the High Performance Computing Symposium – HPC 2000, Ed. A. Tentner, 2000 Advanced Simulation Technologies Conference, Washington D.C. USA p.66-71
12. Ignatyev M. (2002) "Linguo-combinatorial world picture and reality cognition" Congress-2002 Proceedings "Fundamental problems of natural sciences and engineering" Part 2, St-Petersburg, Russia, p. 116-128.

13. Ignatyev M.B. (2002) "Linguo-combinatorial method for complex systems simulation" Proceedings of the 6th World Multiconference on Systemics, Cybernetics and Informatics, vol.XI, Computer science II, Orlando, USA p.224-227.
14. Ignatyev M. and Pinigin G.(2003) "Linguo-Combinatorial Simulation of Universe" XXV General Assembly of International Astronomical Union, Sydney, Australia. www.xxy.astro.com.
15. Ignatyev M.B. and other " Virtual worlds architecture",monograph, St-Petersburg, 2009.
16. Ignatyev M., Simatos N., Svasundaram S."Aircraft as adaptive nonlinear system which must be in the adaptational maximum zone for safety" Proceeding of the first international conference on nonlinear problems in aviation and aerospace, Embry-Riddle Aeronautical University, Daytona Beach, Fl, USA, 1996,p.281-287.