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INTELLECTUAL HEURISTIC MODELS OF REPROGRAMMABLE SWITCHING STRUCTURES ON THE ELEMENTS BY BEREZOVSKY

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ІНТЕЛЕКТУАЛЬНО-ЕВРИСТИЧНІ МОДЕЛІ РЕПРОГРАМОВАНИХ КОМУТАЦІЙНИХ СТРУКТУР НА ЕЛЕМЕНТАХ БЕРЕЗОВСЬКОГО

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ИНТЕЛЛЕКТУАЛЬНО-ЭВРИСТИЧЕСКИЕ МОДЕЛИ РЕПРОГРАММИРУЕМЫХ КОММУТАЦИОННЫХ СТРУКТУРНЫХ ЭЛЕМЕНТАХ БЕРЕЗОВСКОГО

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Abstract.*Annotation The author's position regarding the features of the model of the future 4th industrial revolution, involving the merging and combination of technologies, is described. This approach assumes the formation and expansion of a single information space or the formation of a new paradigm - 2D, 3D, 4D ... plane technologies of telecommunication networks, in which the tasks of modernization, development, and introduction of innovations are easily solved. An example of 2D separation technology into 2 planes (data (Data plane DP) and control (Control plane)) is SDN (Software Defined Networking). The SDN "consolidates" the control plane, with one set of control programs on the server controlling many devices on the data plane. Emphasizes the special relevance of the development of promising topological solutions of DP for telecommunication networks, artificial intelligence systems. For the synthesis of new 2D, 3D topologies, "switching patterns" are needed, for example, as the switching element by Berezovsky (SEB). SEB is the base for the 3D N-dimensional switching elements - frameworks. Graphic 2D, 3D models of a SEB are cognitive models that can contain a wide range of information, determined by the level of education, professional experience and personal maturity of both designers and consumers. The basic generator and component of the SEB is Berezovsky's fully accessible flat 2D switching element and the definition introduced by the author for its presentation — the "switching pattern" —a 2D graphic image using a second-order geometric line — an ellipse. 2D, 3D topological solutions are proposed using SEB models for telecommunication information technology based on intentional thought-images, enabling the researcher to create his own polycharacter material as an innovative interactive graphic database (IBD) for the formation of special knowledge bases (SBB).*

Keywords: *switching elements by Berezovsky, models of switching elements by Berezovsky, 2D / 3D switching structures on elements by Berezovsky, "switching pattern" by Berezovsky*

Анотація. *Викладено позицію автора щодо особливості моделі майбутньої 4-ї промислової революції, яка передбачає злиття і комбінації технологій. Такий підхід передбачає формування і розширення єдиного інформаційного простору або формування нової парадигми – 2D, 3D, 4D ... площинних технологій телекомунікаційних мереж, в яких легко вирішуються завдання модернізації, розвитку, впровадження інновацій. Прикладом 2D технології поділу на 2 площини (даних (Dataplane DP) і управління (Control plane)) є SDN (Software Defined Networking). SDN«консолідує» площину управління, при цьому один комплекс керуючих програм на сервері керує багатьма пристроями на площині даних. Акцентується особлива актуальність розробки перспективних топологічних рішеньDPдля телекомунікаційних мереж, систем штучного інтелекту. Для синтезу нових 2D, 3D топологій потрібні "комутаційні патерни", наприклад, як комутаційний елемент Березовського (КЕБ).КЕБ –*

база для 3DN-мірних комутаційних елементів –- фреймворків. Графічні 2D, 3D моделі КЕБ– когнітивні моделі, які можуть містити широкий набір інформації, який визначається рівнем освіти, професійного досвіду і особистісної зрілістю як проектувальників, так і споживачів. Базовою утворюючою і складником КЕБ є повнодоступний плоский 2D-комутаційний елемент Березовського і вводиться автором для його подання дефініція – «комутаційний патерн» – 2D графічний образ з використанням геометричної лінії другого порядку – еліпс. Запропоновано 2D, 3Dтопологічні рішення із застосуванням моделей КЕБ для телекомунікаційної інформаційної технології на основі інтенціональних мисле-образів, що дають досліднику можливість створювати власний полізнаковий матеріал як інноваційну інтерактивно-графічних базу даних (ІБД) для формування в наслідок спеціальних баз знань (СБЗ).

***Ключові слова**: комутаційні елементи Березовського, моделі комутаційних елементів Березовського, 2D/3D комутаційні структури на елементах Березовського, «комутаційний патерн» елемента Березовського*

***Аннотация**- Излагается позиция автора относительно особенности модели будущей 4-й промышленной революции, предполагающей слияние и комбинации технологий. Такой подход предполагает формирование и расширение единого информационного пространства или формирование новой парадигмы –2D, 3D, 4D…плоскостных технологий телекоммуникационных сетей, в которых легко решаются задачи модернизации, развития, внедрения инноваций. Примером 2D технологии разделения на 2 плоскости (данных (Dataplane DP) и управления (Control plane)) является SDN (Software Defined Networking).SDN «консолидирует» плоскость управления, при этом один комплекс управляющих программ на сервере управляет многими устройствами на плоскости данных. Акцентируется особая актуальность разработки перспективных топологических решений DP для телекоммуникационных сетей, систем искусственного интеллекта. Для синтеза новых 2D, 3D топологий нужны "коммутационные паттерны", например, как коммутационный элемент Березовского (КЭБ).КЭБ - база для 3DN-мерных коммутационных элементов – фреймворков. Графические 2D, 3D модели КЭБ – когнитивные модели, которые могут содержать широкий набор информации, определяемый уровнем образования, профессионального опыта и личностной зрелостью как проектировщиков, так и потребителей. Базовой образующей и составляющей КЭБ является полнодоступный плоский 2D-коммутационный элемент Березовского и вводимая автором для его представления дефиниция – «коммутационный паттерн» – 2D графический образ с использованием геометрической линии второго порядка – эллипс. Предложены 2D, 3D топологические решения с применением моделей КЭБ для телекоммуникационной информационной технологии на основе интенциональных мысле-образов, дающих исследователю возможность создавать собственный полизнаковый материал как инновационную интерактивно-графических базу данных (ИБД) для формирования в последствие специальных баз знаний (СБЗ).*

***Ключевые слова**: коммутационные элементы Березовского, модели коммутационных элементов Березовского, 2D/3D коммутационные структуры на элементах Березовского,«коммутационный паттерн» элемента Березовского.*

INTRODUCTION

Currently, more and more research is devoted to the consideration of heuristics (“heuristics” from the Greek– I find) as the science of creativity, the creative activity of people in order to obtain new results in various fields [1]: cybernetics, medicine...

The experience of creating models has shown that for modeling, functioning and interaction of objects in cases when the physical properties of the model turn out not to be important, it is preferable to use intellectual methods of knowledge representation for describing the functions of the model – graphic images.

Such an approach will find wide application in various design systems and design engineering; it will allow not only to obtain high-quality solutions, but also to exchange knowledge between groups of engineers with extensive experience in various aspects of the tasks to be solved.

Bringing different types of models to single components of the modeling environment allows the designer of *switching structures, systems and networks* (SSSN) to develop *intellectual heuristic models* (IHM), using various options of implementing sub models.

Regardless of whether the functions of the model are implemented in a specialized programming language or described in the form of rules, the user will operate on them in the same way.

1 NEW PARADIGM OF SOFTWARE-DEFINED SWITCHING INFRASTRUCTURE

In terms of architecture, the branch of switching structures, systems and networks *(SSSN)* has stopped in its development for many years since the beginning of the 90s of the last century.

The situation began to change rapidly with the penetration of the ideas of programmable network infrastructures (Software Defined Networking) (hereinafter referred to as SDN), into the world of the SSSN, and additional catalysts were those that have not yet received stable Russian names, products like bare metal, white box and bright box.

Today, the new architecture consists of numerous advanced technologies and is adaptive, dynamic, manageable, cost-effective, which makes it ideal for dynamic modern applications that require high bandwidth – these are *software-defined switching structures, systems and networks* (SDSSSN).

Crucially: this architecture separates the network functions of control and transmission, which allows to make control over the network directly programmable.

For SDN, the most likely set of capabilities is determined:

- support for dynamic movement, replication and distribution of virtual resources;
- easing administrative burdens on configuration, as well as improving service quality and safety;
- easier deployment and scaling of network functionality;
- traffic regulation due to end-to-end network transparency;
- more efficient management of network resources;
- reduction in operating costs;
- faster development of network functionality based on the life cycle of software development;
- the possibility of dynamically query by service applications from the network;
- implementation of more efficient safety features;
- simplification;
- liveness;
- openness of architectural basic solutions of the data plane switch.

SDN allows network managers to very quickly configure, manage, protect and optimize network resources due to dynamic, automated programs that they can create themselves, because the programs don’t depend on proprietary software.

In a pure SDN switch, all management functions of a traditional switch are performed in a central controller. Switch functionality is entirely limited by the data plane.

Researchers continued their work in the direction of separation of planes and started developing the so-called “clean-slate” of architecture, by analogy with object-oriented programming. In a 4D project, four planes have been proposed for a greater degree of abstraction:

– data plane for processing packets based on configurable rules;

– discovery plane to collect information on the topology and traffic measurement;

– dissemination plane for setting packet processing rules on network nodes;

– decision plane, consisting of logically centralized controllers transforming network layer targets into packet processing states.

The first project with the processing of traffic flow tables was implemented in the scientific department of Stanford University and laid the foundation for the development of the Open Flow protocol.

It also enabled a wider number of manufacturing companies to create switches without the need for large investments in the design and manufacture of their own equipment for the data plane [2].

2 CLOUD TECHNOLOGIES AND ARTIFICIAL INFORMATION COORDINATES OF SPACE

Cloud technologies gradually penetrate into all spheres of human activities, help to effectively organize external and internal communications.

New theories appear that allow building creative figurative planar and spatial models of reflection of the surrounding world. These models are used in many scientific fields to describe the properties of the real world and expand the information space of a human designer and the capabilities of the latter.

Artificial information space is created by a man on the basis of the knowledge, theories, models, systems and processes of knowledge he is possessing.

An example of an artificial information space is the coordinate space, which is set by a man on the basis of the coordinate systems entered by him and undefined selected reference points for these systems. A characteristic feature of the information space is the presence of the information relations in it of a part and the whole, topological relations, semantic relations, linguistic relations, etc. (Figure 1).

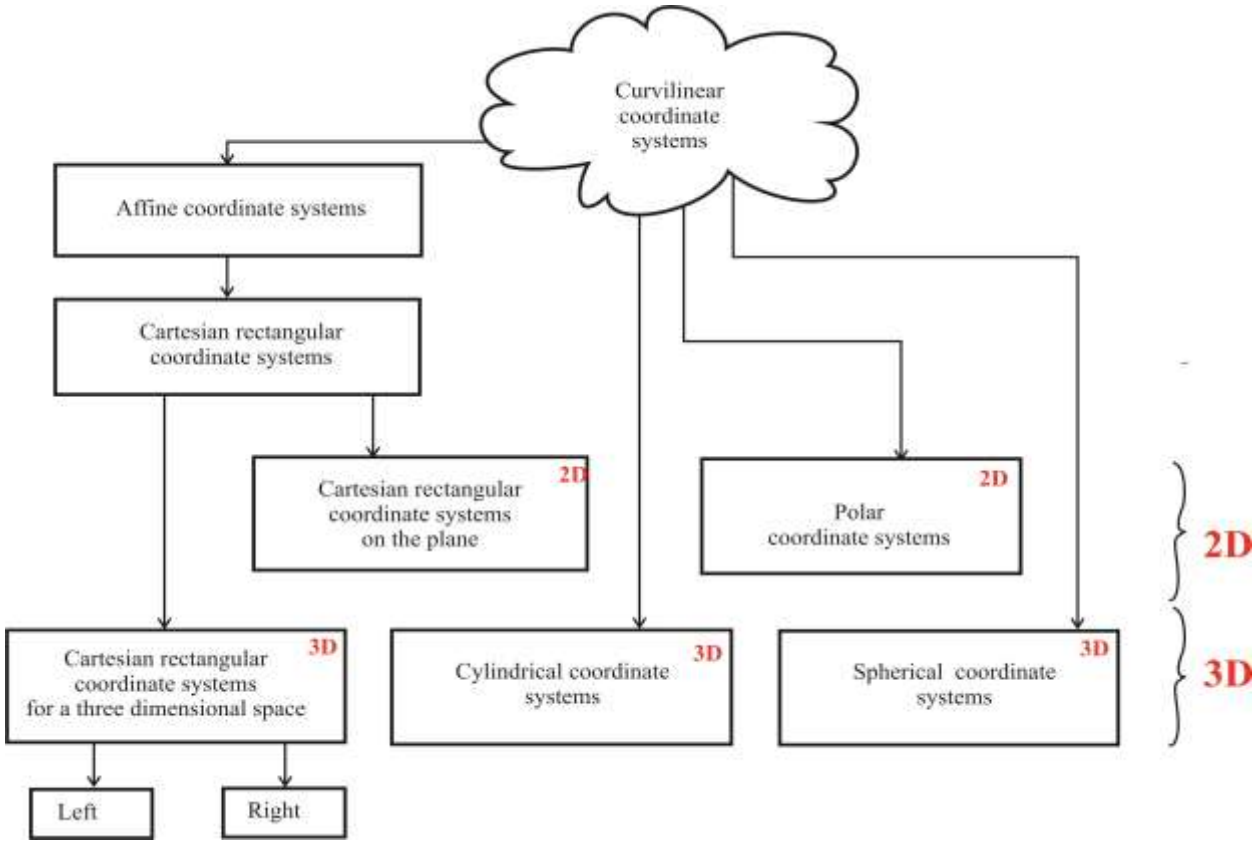

Figure 1 – Coordinate systems of artificial information space

Artificial information space is some descriptive information model. One of the immediate prospects of science is the development of a new technology of interactive-graphic interconnection of a man and his imaginative mechanisms of creative thinking, not just with ECM, but directly with the problem under study itself.

The success of Hardware and Software development allow us to intensify the process of creating Brainware – a set of intelligent algorithmic tools that represent the actual basis of the whole methodology of modern mathematical modeling and computational experiment. One of such means of modern information technology is dynamic interactive computer graphics.

3 MODELS

Scientific research is the creative activity of the developer, determined by the triad "purpose-means-result", which determines the development of technologies in society, including professional and communicative ones.

Leading software companies offer architectures capable of developing a physical environment and at the same time moving to cloud environments. Developments are characterized by close integration both on the physical (through modules and devices) and on the logical level (by the effect of close connection with the switching and routing matrix).

SDN is nothing more than a *tool* to facilitate solving network management problems and it provides an opportunity to develop new applications and solutions for "long-running" problems.

Currently the question of how easy it is to use cloud computing is being actively discussed, but it is not specified how to build a SDSSSN for cloud structures without new 2D, 3D model types and new 3D N-dimensional switching elements - frameworks.

3.1 New 3D N-dimensional framework for cloud structures

The use of new reprogrammable 2D and 3D switching elements will make it possible to remove the urgency of some of the noted problems when solving problems of SDSSSN synthesis.

As a "building" element i.e. framework of SDSSSN it is proposed to use the patented switching element by Berezovsky (SEB-1)) (reference character $\underline{B^{\#}}$) [3].

The fundamental unit and constituent part of the SEB is fully accessible flat 2D switching element by Berezovsky and the definition introduced by the author for its presentation that is **"switching pattern"**– a 2D graphic image using a geometric line of the 2nd order – an ellipse (Figure 2).

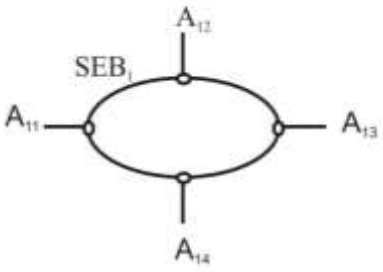

Figure 2 – 2D Graphic frame model of the switching element by Berezovsky (SEB-1)

The model of the SEB framework can be represented:

- in black and white $\underline{B^{\#}}(^{B}/_{W})$,
- in color without specifying the used color model $B^{\#}(C)$
- in color indicating, for example, $\underline{B^{\#}}(RGB)$ or $\underline{B^{\#}}(HEX)$

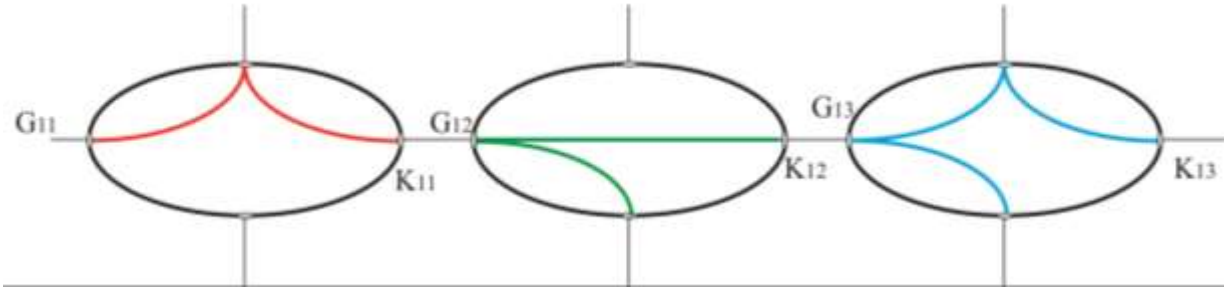

Figure 3 – Horizontal uncolored switching module with the states of the SEB

The state of the framework model $\underline{B^{\#}}$is set by the characteristic equations *Wj* [3] and it is proposed to reflect using algebraic lines of the first and second order between the "input-output" terminals, Figure 3.

Synthesized and patented N-dimensional 3D switching element by Berezovsky (SEB-2) (reference character $\underline{B_N^{\#}}$), which allows to solve some of the listed problems: to carry out centralized control, precise configuration, and troubleshooting in the context of complex and routine tasks of SDSSN control [4].

The SEB implements a set of states that are described by characteristic equations [3,4,5 – English version of the SEB-2 patent description, submitted by the patent office].

In the general case, the data structure of the CEP frame model may contain a wide range of information, determined by the level of education, professional experience and personal maturity of both designers and consumers and it is not reflected in this article.

The specificity of the 3D frame SEB model predetermines the conditions for programming models on a digital computer. Programs must be flexible, blocky, allow undefined change of any value, any characteristic, since during the debugging of the model it is necessary to make adjustments in order to get some final "exits" – topologies assumed by the synthesis hypothesis.

The use of switching structures with channel switching isn't currently well studied, but it can be assumed that this mode will be effective for transmitting very large amounts of information with high reliability requirements.

3.2. 2D Intellectual and heuristic models for telecommunication information technology based on Berezovsky's switching elements

The need for developers and consumers to have operational information about the structure, composition, condition, etc. of switching element (SE) predetermined borrowing the well-known concept of an abstract image –model from psychology and philosophy for understanding some stereotype of perception.

Of particular interest is the formation of adequate graphical intellectual and heuristic models for telecommunication information technology based on intensional thoughts-images, giving the researcher the opportunity to create his own polysymbolic material as an innovative interactive graphic database (IGD) for the formation of a special knowledge base (SNB) and type of thinking of a man/operator, suggesting variability in the process of choosing the architectonics of models and SDSSSN.

The topology of an *intelligent heuristic* flat ordinary homogeneous in the Cartesian coordinate system of an uncolored model of the switching structure without displaying the switching states of certain switching elements by Berezovsky SDSSSN is shown in Figure 4.

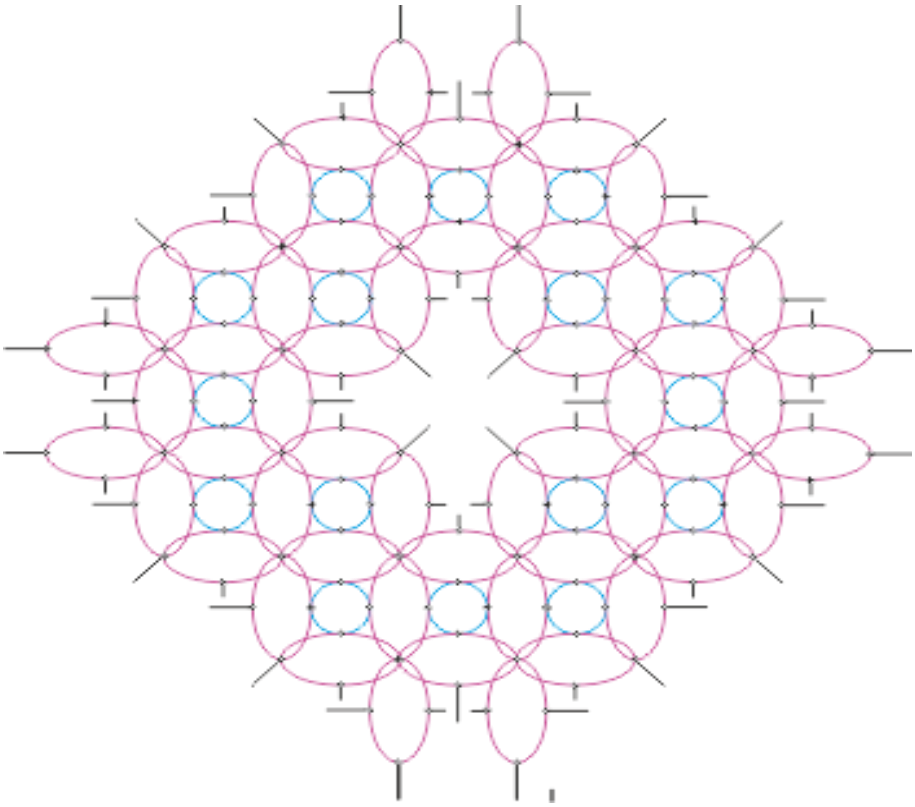

Figure 4 – Intellectual and heuristic flat ordinary model in the Cartesian coordinate system uncolored without displaying the switching states of certain switching elements by Berezovsky SDSSSN.

The *intellectually heuristic* flat ordinary in the affine coordinate system uncolored model of SDSSSN, without displaying the switching states of certain switching elements by Berezovsky, is shown in Figure 5.

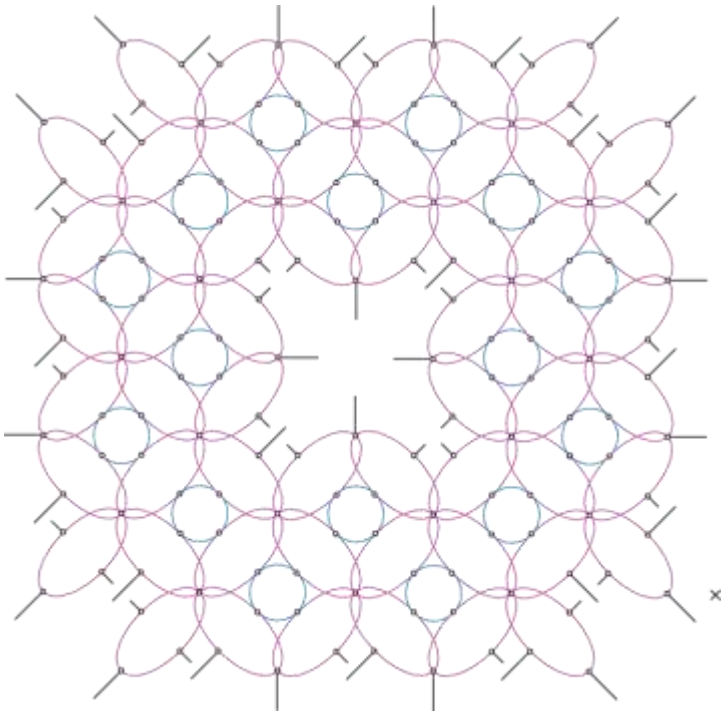

Figure 5 – The *intellectually heuristic* flat ordinary in the affine coordinate system uncolored model of SDSSSN, without displaying the switching states of certain switching elements by Berezovsky SDSSSN.

In the topology of the *intellectual heuristic* model of SDSSSN, SEB-1 is represented by second-order figures – the ellipse and the circle (lilac and blue, respectively).

An example of a packed ***intellectual heuristic*** model of the SDSSSN is shown in Figure 6.

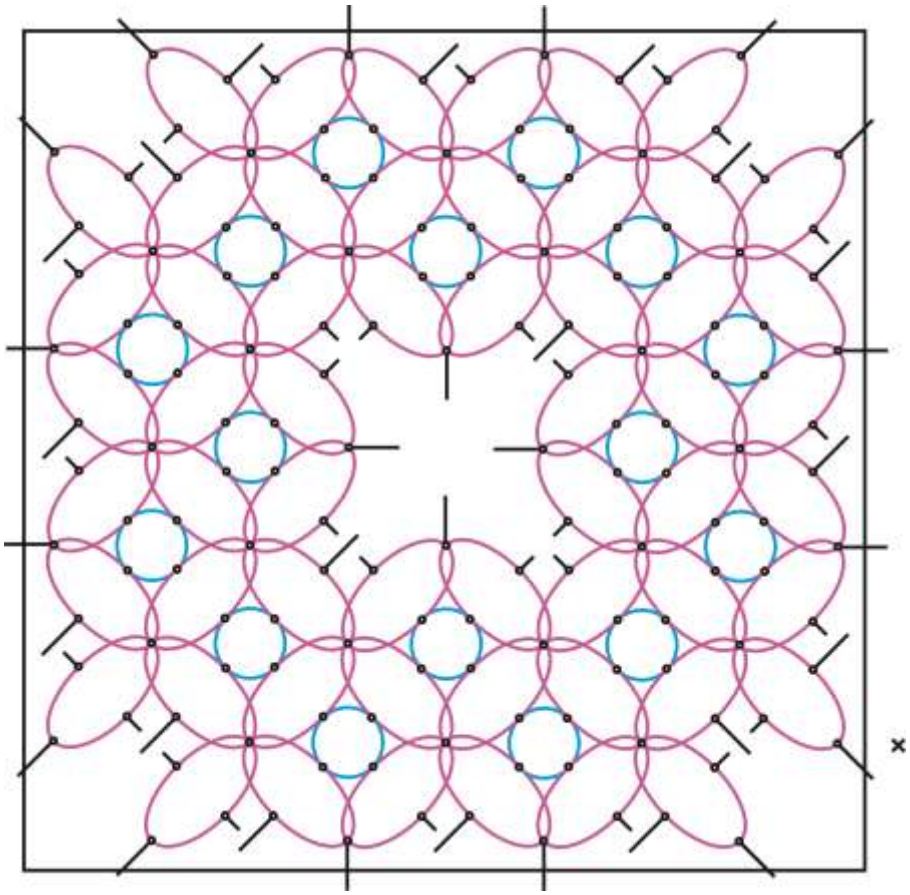

Figure 6 – Intellectual and heuristic flat ordinary model in the Cartesian coordinate system packed and uncolored without displaying the switching states of certain switching elements by Berezovsky SDSSSN.

The peculiarity of the proposed *intellectual heuristic* colored topology of SDSSSN on a SEB-1 (Figure 7) is the presence of three types of communication channels A_{ij}, $B_{k\,l}$, $S_{v,z}$ with the ratio of delay times $\tau_{з\,min\,A} > \tau_{з\,min\,B} > \tau_{з\,min\,S}$. The presence of such channels expands the possibilities of using the RCSS on the CAB.

The emergence of new three-dimensional integration technologies will solve some 3D problems of modern electronics: the formation of sets of packages from intelligent heuristic flat ordinary models in the *Cartesian* coordinate system, packed, colored, with the display of switching states of certain Berezovsky switching elements, which, in turn, will make it possible to start solving 3D SDSSSN design questions for a new communication technology, automated control systems, computer systems, robotics, and pilotless aerial vehicles.

New SDSSSN can be built using many different elements, including optical ones, and can be fully convergent systems.

Heuristic topologies should be used to implement SDSSSN more effectively.

The intellectual capabilities of the SDSSSN models designer form the number of "words" – variables – slots, which determine the purpose of the model according to the availability of data, which must be manipulated conclusively to model the topology of the structure, which by its purpose assumes high generality.

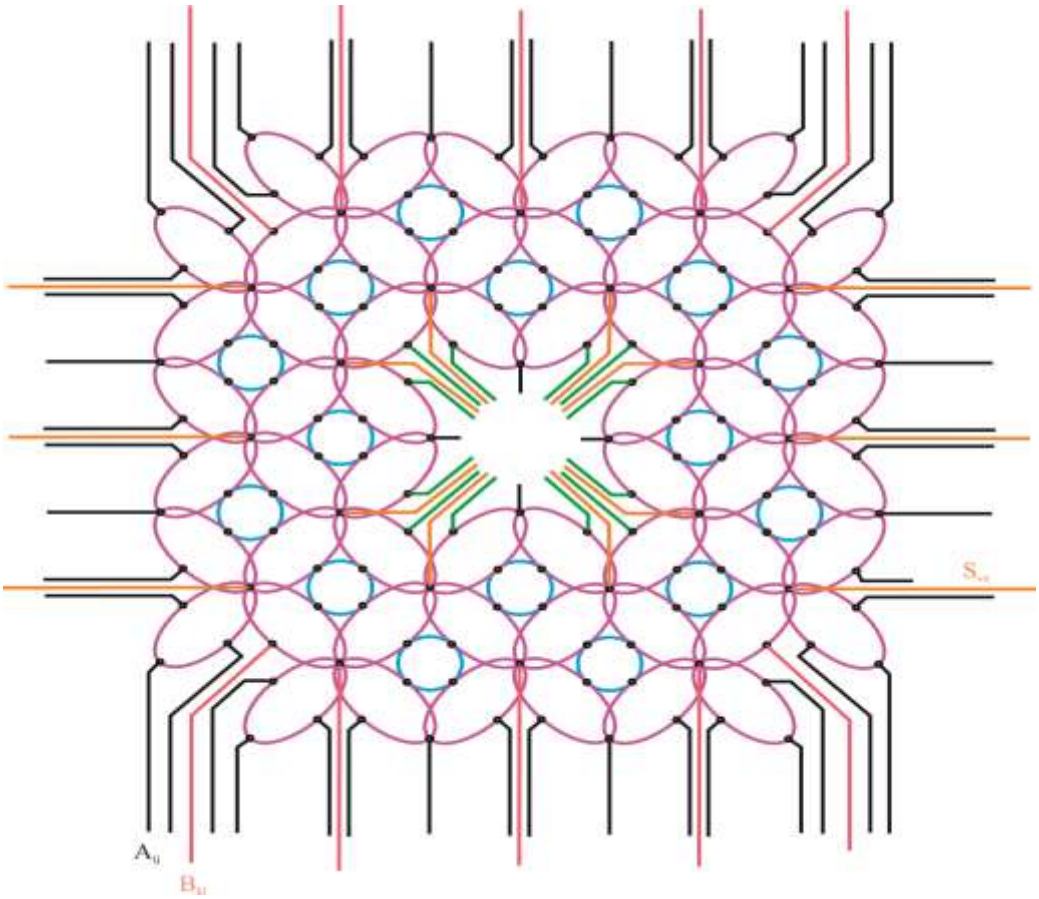

Figure 7 – Intellectual and heuristic flat ordinary model in the affine coordinate system unpacked colored without displaying the switching states of the certain switching elements by Berezovsky SDSSSN

3.3. Intellectual and heuristic topologies on the frame model of a SEB with elements of cognitive graphics

Cognitive computer graphics can provide effective assistance in solving topology problems of the SDSSSN model using the 3D frame model of a SEB.

Methods of cognitive graphics are used in the systems of artificial intelligence capable of transforming textual descriptions of tasks into their figurative representations, and when generating textual descriptions of schemes, topologies, structures as images arising in the input and output blocks of intelligent systems, as well as in human and machine systems designed to solve complex, poorly formalized problems. It becomes possible to form various model images in the mind of the recipient, for example, a multidimensional switching element (MSE) of a complex SDSSSN formed in one of the coordinate systems of space.

When developing a parallel information processing structure, the topology of the switching structure was synthesized – a switching fractal of the “wreath” type (Figure 8).

Such a technology provides a researcher with a highly efficient technical tool for direct, purposeful influence on the processes of figurative thinking of a person, and in the natural conditions of finding a solution to a real scientific problem.

Professor D. A. Pospelov formulated three main tasks of cognitive computer graphics [6]:

- creation of such models of knowledge representation in which there would be a possibility to represent by monotonous means both objects specific of logical thinking and images-pictures with which figurative thinking operates,
- visualization of that human knowledge for which it is not yet possible to select text descriptions (Figures7,8),

- search for ways of transition from the observed images-pictures to the formulation of a hypothesis about the mechanisms and processes hidden behind the dynamics of the observed pictures.

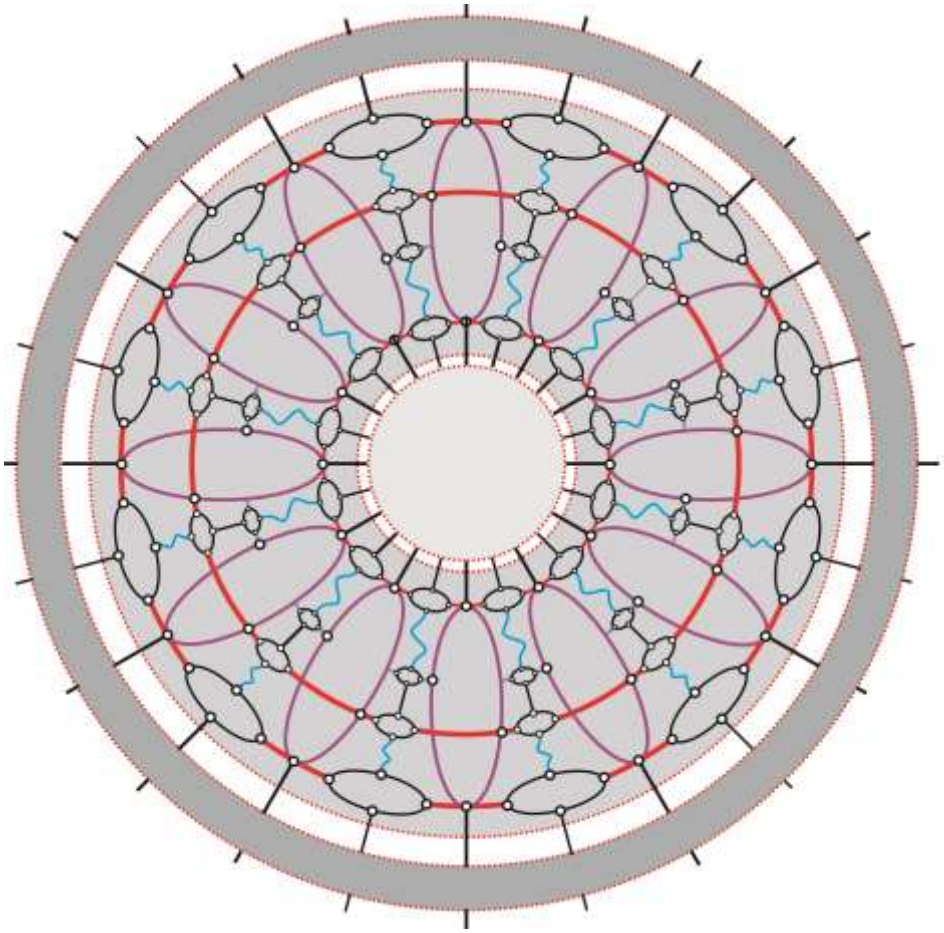

Figure 8 – Intellectual heuristic flat model in the Cartesian coordinate system colored without displaying the switching states of certain switching elements by Berezovsky SDSSSN "Switching fractal" of the "wreath" type.

When developing a parallel structure of information processing, the topology of the switching structure – a switching fractal of the "wreath" type (Figure 8) was synthesized.

The SDSSSN topology (Figure 9) of information collecting A_{1j} with j = 24 directions and transmitting it in accordance with a given algorithm (not considered in the article) to the information tunnel F_i (not shown in the figure).

The callout provides information on the status of the CEB-1.

A distinctive feature of the intellectual heuristic model of the structure is that it consists of several components obtained by affine transformations: rotation, compression and reflection of the original set of simple frame-based models of the SEB. This structure contains 64 connection points, possibly symmetric and asymmetric scaling for a specified number of connection points.

3.4 3D Intellectual heuristic topologies on the CEB frame model

Adherents of a particular conceptual model consciously (and sometimes subconsciously) selected only those knowledge that agreed with the accepted conceptual model, rejecting those knowledge that contradicted (or minimized their plausibility). In other words, a kind of "psychological defense" mechanism was used against knowledge destroying the accepted conceptual model, which was justified by the accepted system of knowledge.

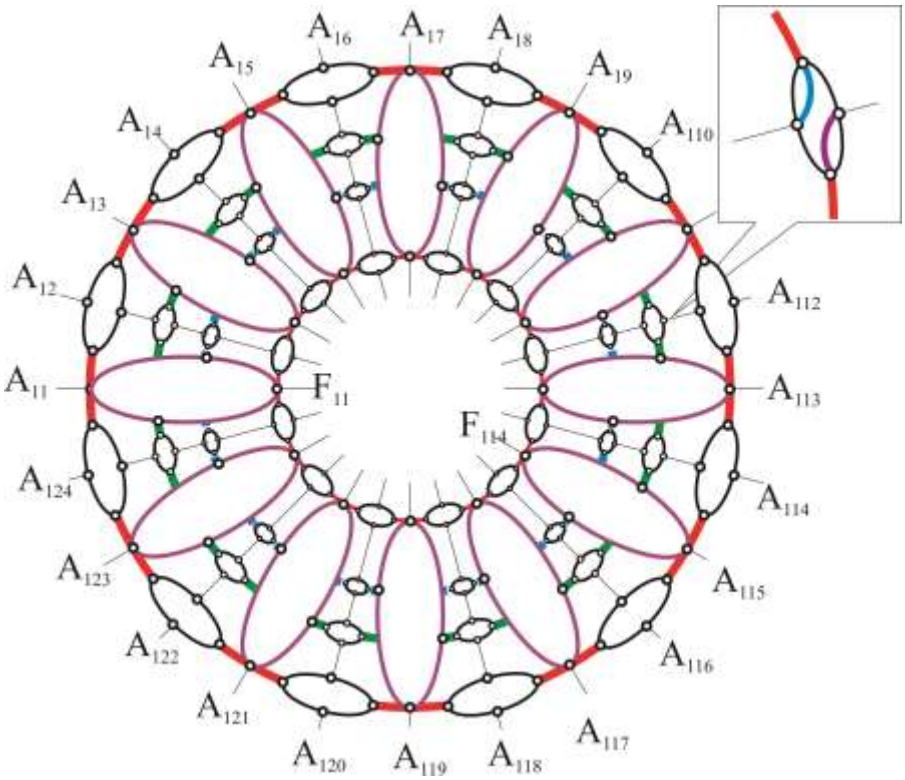

Figure 9 – Intellectual heuristic flat model in the Cartesian coordinate system unpacked colored displaying the switching state of a separate switching element by Berezovsky SDSSSN in the callout

The 3D intellectual heuristic model colored with the display of switching states of certain switching elements by Berezovsky SDSSSN of information collecting into an information tunnel (colored blue) (Figure 10).

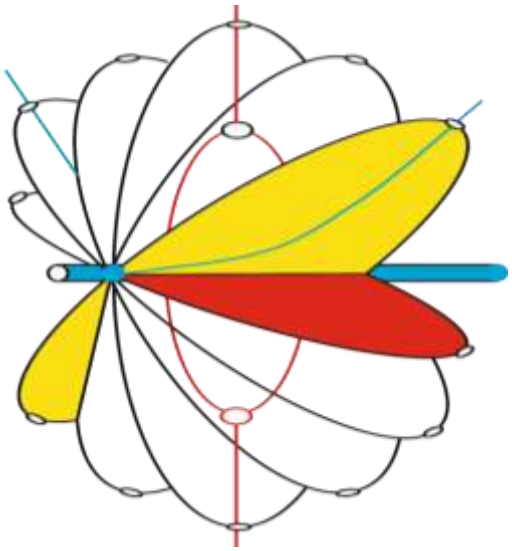

Figure 10 – 3D intellectual heuristic *model* colored with the display of switching states of individual switching elements by Berezovsky SDSSSN of collecting information into the information tunnel

Obviously, real models of systems of the "type of living" should be of such complexity that it was possible to create new objects (and, including, for artificial intelligence) using them, and even reconstruct them (Figure 11).

For complex SDSSSN, an entire system of operating models must be prepared: complete, of different degrees of generalization, and particular, in which the details are reproduced. These models will reflect different levels of the structural hierarchy (Figure 10).

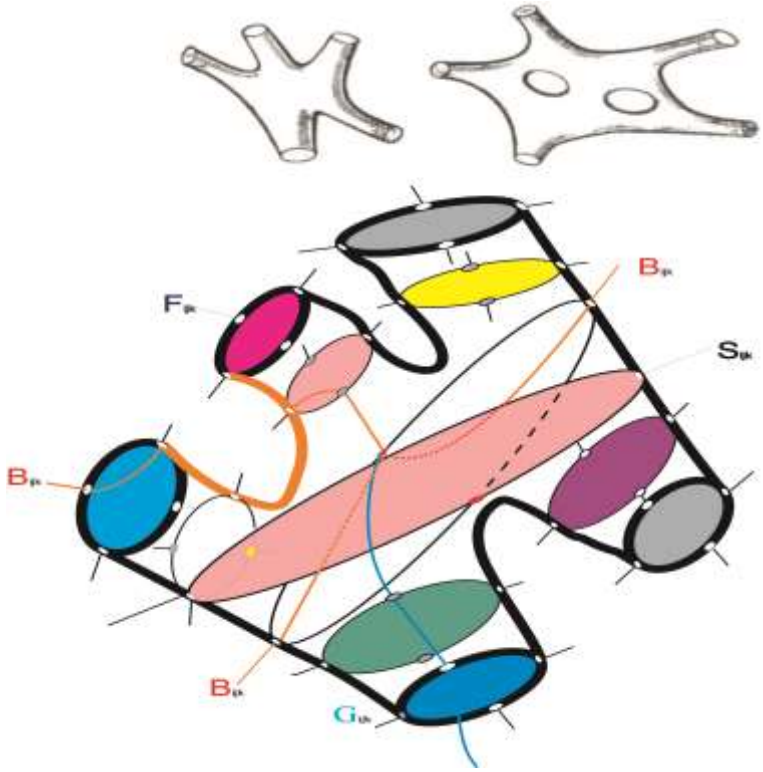

Figure 11 – 3D intellectual heuristic colored with the display of the switching states of certain switching elements by Berezovsky SDSSSN model for information collection.

However, no matter how complex the models are, they will always be just probabilistic. Therefore, in order to use such models, they will have to be “tied” or “tuned” to the object, but even in this case, only probabilistic similarity with correction is possible using the feedback effect.

Taking into considering that the higher the specialization of the applied set of tools - the intellectual and heuristic frame models of the SEB with elements of cognitive graphics, the higher the quality of the work on designing the topologies of the SDSSSN(Figures 9,12). The author has developed a dynamic associative library (DAL) of states for the switching elements by Berezovsky (based on SEB-1, SEB-2).

The use of DAL provides the ability to implement the design algorithms for the topology of the SDSSSN in a generalized form, based on the original graphic data of the implemented topology.

Complex SDSSSN are hierarchical in structure, contain many “horizontal” links within the level and “vertical” links between them. Variables at different levels have different specificities and temporal characteristics. All this must be presented in the model, sometimes with the help of additional variables reflecting the quality of the main ones.

A new approach is proposed for building intellectual heuristic SDSSSN models, which is designed to use system resources efficiently and, as a result, to ensure the achievement of maximum high speed response.

CONCLUSION

1 In the presented material it is proposed to use intellectual heuristic models of knowledge representation for figurative visualization of the topologies of the SDSSSN, which proves the novelty and originality of the result.

2 Intellectual and heuristic models bring us closer to the theory of the systems of “living type”, allowing us to predict their behavior, research possibilities of management and even reconstruction.

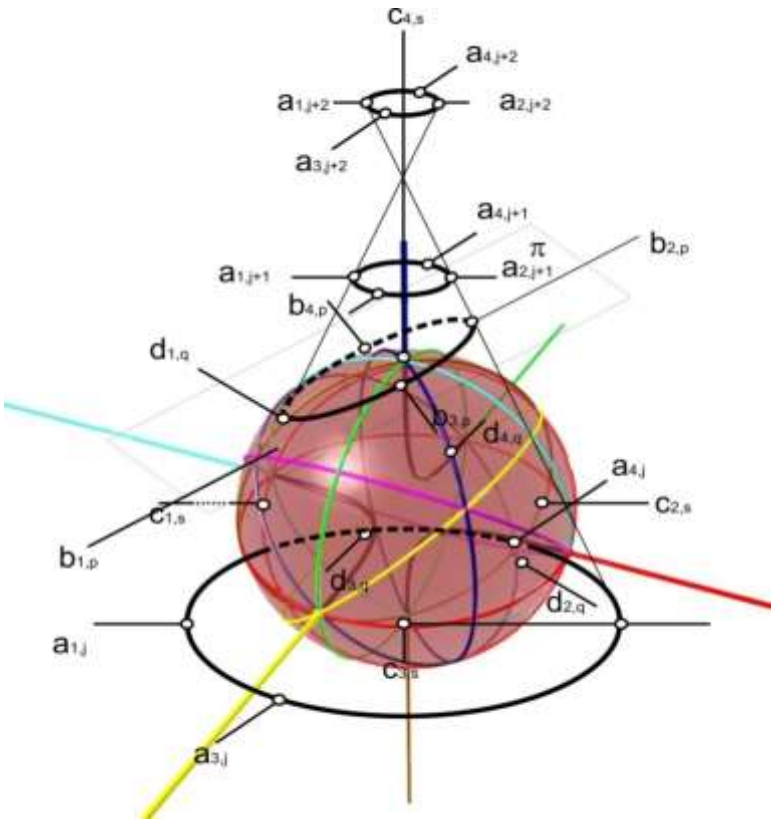

Figure 12 – A 3D intellectual heuristic pyramidal *model* colored with the display of switching states of certain switching elements by Berezovsky SDSSSN

3. Intellectual and heuristic models provide a completely new instrument of knowledge. Such models of the "type of living" form the basis for the construction of real models in the future designed to replace the traditional "book" models of modern science.

4. The standard geometric shapes have been used in the intellectual heuristic models. This is a very important condition, as it allows refusing from complex mathematical descriptions.

5. Intellectual and heuristic models provide a researcher a highly efficient technical tool for direct influence on the processes of figurative thinking of a person / developer / operator in natural conditions of finding a solution to a real scientific problem.

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