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The Synthesis, Analysis and Ontologization of Species of Homeostatic Network Structures

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Abstract: The paper is devoted to fundamental investigation in the area of Homeostatics concerning to the research of homeostatic networks the "Eikomorphology". The description of the morphological synthesis of homeostatic networks of the "Eikos" class based on formal mathematical apparatus of stages is represented. The axiomatic of species of structures theory of adaptive systems is analyzed and new set-theoretic mathematical models of homeostatic network system are generated. Analysis of mathematical models makes it possible to define three types of homeostatic networks as control models. The ontologization (objectification) of set of homeostatic network systems is based on an approach developed in the science that studies the theory of classification and classifying, which is the study of classification of objects of any nature. As a classifying method of the whole methodological array the formal mathematical apparatus of the classification system was selected. The result of the classification machine is a two-dimensional table with polar scales, generation of which is described in the article, containing an ordered finite set of homeostatic network patterns, analysis of some of which allows to identify and describe some of the existing real systems with the positions of the homeostatic approach and to design the new ones.

Key words: Theory of species of structures · Homeostat · Mathematical model · Apparatus of stages · classification system · Homeostatic network pattern

INTRODUCTION

Currently, the scientific task of ensuring the stability that solved in technical, managerial and other activities tend to take into account the increasing number of requirements for a range of new technologies. There are many mechanisms to ensure system stability in the technosphere were implemented, but due to the constant development of artificial systems engineers have to look for new ways to solve a giant and one of the most difficult scientific problems - the problem of the stability of technical systems. The phenomenon of stability of technical systems studied by such scholars as Lyapunov, Hurwitz, Mikhailov, Nyquist, Ashby etc. From the viewpoint of system approach the stability increases in the process of systems evolution. The most advanced systems have the quality of purposefulness, which is associated with the presence of systemic mechanisms of self-organization. Such adaptivization (reinforcing of process adaptability of systems to the environment) [1] mechanisms are present in natural systems of the high levels of progress. Control in such systems is a multi-purpose and multi-parameter character at all levels of controlling. This approach allows to provide multistability of complex systems at various influences of the environment. In the design of artificial stable systems the solution of problem of the adaptive stability ensuring is urgent.

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In the investigations [2, 3] was determined the fact that the most stable and advanced systems are those one that relate to the metaclass of the homeostatic systems. Based on the research [3] in this metaclass a new class of homeostatic control system with group character of development - the "Eikos" class, - was defined. The elements of "Eikos" are the homeostatic networks and use multi-loop connected adaptivization mechanisms and the controlling is realized by strategizing on the basis of a scenario approach, which is an effective method for predicting a complex situation and also allows to define the unexpected solutions in complex systems.

The aim of this investigation is the generation and ontologization of new structures species of homeostatic networks in the form of a finite set of abstract morphological models belonging to the "Eikos" class and described on the basis of the Set Theory.

To achieve this goal the following objectives are determined:

- The analysis of axiomatic of the formal theory of control systems;
- The generation and analysis of mathematical models of the homeostatic network system;
- The synthesis of a finite set of abstract homeostatic network models based using the Nikanorov's mathematical apparatus of stages [4];
- The ontologization of a finite set of abstract homeostatic network models using the Subetto's formal mathematical apparatus of the classification system [5].

MATERIALS AND METHODS

In [1] an axiom that establishes the existence of structures of homeostatic type in the cause-effect network of control systems is presented:

$$Ax_6 : \forall d \in D_2, \forall x \in X_1, \forall y \in X_1, \forall z \in X_1 (pr_1 d = (x,y)) \,\&\, (pr_2 d = z) \,\&\, (\exists a \in X_2 ((y,a) \in D_1) \,\&\, (x,a) \in D_1)))$$

where X_1 - control system, X_2 - control object, generic terms: $D_1 \in B(X_1 \text{ x } X_2)$, $D_2 \in B(X_1 \text{ x } X_1)$; $pr_1 d$ -definitional domain of equivalence [6], $pr_2 d$- range of values of equivalence [6].

Thus, the formal axiomatic theory allows to identify some subsets of three-loop control systems as a subsets of control objects that under the controlling of some subsets of control systems. Described network control cascade is determined in two basic types of homeostatic cause-effect control systems network [1]:

- Reflexive homeostatic network - a network of hybrid structure, in which a layer of adaptivization subsystems (reflexive loops) located around the main homeostatic control loop.
- Pure homeostatic network - a homeostatic network, in which the controlling of set of homeostats is implemented by homeostats.

Axiomatic formal theory allows to formalize the cause-effect control systems networks of the "multistorey homeostatic" form [1] as a simple and chromatic graphs and hypergraphs[1], which is not contradict with the known model of homeostats fractal organization in the functional nets [7]. Such formalization can be named as "structural formalization". Another type of formalization, "component", will identify in a cause-effect control systems networks components and relations between them.

Of Homeostatics [7] and Medical Homeostatics [8] it is known the six based homeostatic structures. According to the study consider them as subsets of the set, with the separation of belonging to the subjective and objective part of the system.

For the control object are typically the following sets of homeostats [7]:

- A set of compensating homeostats $\{CH\} \in X_2$;
- A set of planetary homeostats $\{PlH\} \in X_2$;
- A set of pulsating homeostats $\{PH\} \in X_2$;
- A set of rhythmic homeostats $\{RH\} \in X_2$;

For the control system are typically the following sets of homeostats [7]:

- A set of magnetic field homeostats $\{M\text{-}FH\} \in X_1$;
- A set of information field homeostats $\{I\text{-}FH\} \in X_1$;

There are several well-known types of relations [7] on the set of homeostats:

- Allied $\oplus$ (effect of homeostats are added);
- Amicable $\otimes$ (effect of homeostats are multiplied);
- Competitive Θ (effect of homeostats are subtracted).

[1]http://www.supir.ru/index.php

There are several well-known features [7] on the set of homeostats, which are given numerical sequence based on qualitative expert assessments, where 1a, 1b, etc. - qualitative assessment:

- The functional purpose (0, 1, 2);
- The quality level of homeostasis (0, 1a, 1b, 1c, 1d, 2a, 2b);
- The complexity of the structure (0, 1, 2, 3, 4, 5, 6);
- Viability (0, 1, 2, 3, 4, 5, 6);
- The level of functioning (0, 1a, 1b, 1c, 1d, 2a, 2b);
- The level of controlling (0, 1, 2);
- The quality level of noise cancellation (0, 1a, 1b, 1c, 1d, 2a, 2b);
- The resistance of antagonists (0, 1, 2, 3, 4, 5, 6);
- Self-compensation (0, 1, 2, 3, 4, 5, 6).

For a “component” formalization it is required to generate a mathematical model of the homeostatic control system as a set-theoretical description. For the generation of the mathematical model of the homeostatic network the following auxiliary concepts using terms of the Set Theory [6] were introduced:

M - Set of basic elements of the system;
I - True subset of elements;
R - Set of relations of elements of the system;
P - Set of properties of the elements of the system;
C - Set of system goals;
Q - Set of all possible structures of the system;
Qn - Subset of suitable structures;
F - The set of all possible functions of the system.

The general set-theoretic model of the structure of the system has the next appearance:

$$Q = (M, R, ((C \subset P) \subset F)),$$

where

- The set of the basic elements of the system consists of the set of known homeostats *M:* {*CH, PlH, PH, RH, M-FH, I-FH*};
- The generic terms of axiomatic theory are in the inclusion with a set of basic elements of the system;
- Sets of allied, amicable and competitive relations are the strict subsets of the set of system elements relations and are defined on the whole set of basic elements of the system $R\oplus R\otimes R\Theta\subset R$, where $R\oplus \neq R\otimes \neq R\Theta$ and $R\subseteq M^n$, where n- the number of basic system elements set;
- The set of goals of the system C is reflected on the set of properties of the system P, the mapping of which in turn is reflected on the set of all possible functions of the system F.

Using the mathematical apparatus of stages [4], we obtain a general extended set-theoretic model of system. Let the set of homeostats M is a totality I.

$I = M$: {*CH, PlH, PH, RH, M-FH, I-FH*}- the set of homeostats.

At the normal stage S_0 the totality is defined as a finite variety of elements of the set.

S_0: I

At the first normal homomorphic stage S_1 the boolean of the set (differentiated variety of groups of set elements) is determined, i.e. 6 groups of subsets of the sets) are determined, defined on formal basis - the number of elements (0, 1, 2, 3, 4, 5, 6).

S_1: $B(I)$

At the second normal homomorphic stage S_2 the dekartian (integrator of odd elements) of boolean of the set is determined, i.e. defined between adjacent groups of subsets of the set binary relations. At the following normal homomorphic stages $S_3 - S_7$ dekartian of 2-6 orders ($D^2 - D^6$) of boolean of the set is determine for the binary relations defining for all elements inside the set in the network structure (“all to all”).

$$S_2 - S_7 : D^6 B(I) = \{(ch, plh, pl, rh, m\text{ - }fh, i\text{ - }fh) \mid ch \in CH, plh \in PlH, ph \in PH, rh \in RH,$$
$$m\text{ - }fh \in M\text{ - }FH, i\text{ - }fh \in I\text{ - }FH\}.$$

Thus, taking into account the sign change of the binary relation operation “×” of dekartian as the operator on the operation of relations, which is typical for homeostats, generally written as R, we can get a subset of abstract morphological models of homeostatic networks define the corresponding sets of qualitative assessment. For example, it given the first and fifth group of six:

♦ The first group:

***R*{Ø}**, {0};
***R*{CH}**, {**1**(*1*), **2**(*1a*), **3**(*1*), **4**(*1*), **5**(*1a*), **6**(*1*), **7**(*1a*), **8**(1), **9**(*1*)};
***R*{PlH}**, {**1**(*1*), **2**(*1b*), **3**(*2*), **4**(*2*), **5**(*1b*), **6**(*1*), **7**(*1b*), **8**(*2*), **9**(*2*)};
***R*{PH}**, {**1**(*1*), **2**(*1c*), **3**(*3*), **4**(*3*), **5**(*1c*), **6**(*1*), **7**(*1c*), **8**(*3*), **9**(*3*)};
***R*{RH}**, {**1**(*1*), **2**(*1d*), **3**(*4*), **4**(*4*), **5**(*1d*), **6**(*1*), **7**(*1d*), **8**(*4*), **9**(*4*)};
***R*{M-FH}**, {**1**(*2*), **2**(*2a*), **3**(*5*), **4**(*5*), **5**(*2a*), **6**(*2*), **7**(*2a*), **8**(*5*), **9**(*5*)};
***R*{I-FH}**, {**1**(*2*), **2**(*2b*), **3**(*6*), **4**(*6*), **5**(*2b*), 6(*2*), **7**(*2b*), **8**(*6*), **9**(*6*)};

♦ The fifth group:
***R*{ CH, PlH, PH, RH, M-FH }**, {**1**(*1, 2*), **2**(*1a, 1b, 1c, 1d, 2a*), **3**(*1, 2, 3, 4, 5*), **4**(*1, 2, 3, 4, 5*), **5**(*1a, 1b, 1c, 1d, 2a*), **6**(*1, 2*), **7**(*1a, 1b, 1c, 1d, 2a*), **8**(*1, 2, 3, 4, 5*), **9**(*1, 2, 3, 4, 5*)};
***R*{ CH, PlH, PH, RH, I-FH }**, {**1**(*1, 2*), **2**(*1a, 1b, 1c, 1d, 2b*), **3**(*1, 2, 3, 4, 6*), **4**(*1, 2, 3, 4, 6*), **5**(*1a, 1b, 1c, 1d, 2b*), **6**(*1, 2*), **7**(*1a, 1b, 1c, 1d, 2b*), **8**(*1, 2, 3, 4, 6*), **9**(*1, 2, 3, 4, 6*)};
***R*{ CH, PlH, PH, M-FH, I-FH }**, {**1**(*1, 2*), **2**(*1a, 1b, 1c, 2a, 2b*), **3**(*1, 2, 3, 5, 6*), **4**(*1, 2, 3, 5, 6*), **5**(*1a, 1b, 1c, 2a, 2b*), **6**(*1, 2*), **7**(*1a, 1b, 1c, 2a, 2b*), **8**(*1, 2, 3, 5, 6*), **9**(*1, 2, 3, 5, 6*)};
***R*{ CH, PlH, RH, M-FH, I-FH }**, {**1**(*1, 2*), **2**(*1a, 1b, 1d, 2a, 2b*), **3**(*1, 2, 4, 5, 6*), **4**(*1, 2, 4, 5, 6*), **5**(*1a, 1b, 1d, 2a, 2b*), **6**(*1, 2), ***7**(*1a, 1b, 1d, 2a, 2b*), **8**(*1, 2, 4, 5, 6*), **9**(*1, 2, 4, 5, 6*)};
***R*{ CH, PH, RH, M-FH, I-FH }**, {**1**(*1, 2*), **2**(*1a, 1c, 1d, 2a, 2b*), **3**(*1, 3, 4, 5, 6*), **4**(*1, 3, 4, 5, 6*), **5**(*1a, 1c, 1d, 2a, 2b*), **6**(*1, 2*), **7**(*1a, 1c, 1d, 2a, 2b*), **8**(*1, 3, 4, 5, 6*), **9**(*1, 3, 4, 5, 6*)};
***R*{ PlH, PH, RH, M-FH, I-FH }**, {**1**(*1, 2*), **2**(*1b, 1c, 1d, 2a, 2b*), **3**(*2, 3, 4, 5, 6*), **4**(*2, 3, 4, 5, 6*), **5**(*1b, 1c, 1d, 2a, 2b*), **6**(*1, 2*), **7**(*1b, 1c, 1d, 2a, 2b*), **8**(*2, 3, 4, 5, 6*), **9**(*2, 3, 4, 5, 6*)}.

Based on the results of the using of the mathematical apparatus of stages (the dekartian of boolean of homeostats set), the general set-theoretic model of the structure of homeostatic system is transformed into a general extended set-theoretic model of the system, which has the following form:

$$Qn = (D^m B(\varnothing, CH, PlH, PH, RH, M-FH, I-FH), \{R\oplus, R\otimes, RT\} \subseteq M^n, ((C \subset P) \subset F)),$$

where

m - An order of the dekartian of boolean of the set;
n - The number of elements of the set;

$m = n - 1.$

The general extended set-theoretic model of the system allows to determine three types of networks as a homeostatic control models derived from the theory of Homeostatics by belonging to the homeostatic subjective and objective part of the system:

- The system of network homeostatic control object (S_A) - a model of the control object;
- The system of network homeostatic control subject (S_B) - a model of the controlled system;
- The system of network homeostatic control subject and object ($S_{AB} = S_A \cup S_B$) - a combinational model of the control system of the control object.

To formalize the set of sets as a classification the classification system (CS) [5] is used. For this investigation, the tuple of classification system has the next appearance:

$$CS = < ?_{?}, ?_2, ?_1, ?_1, \theta_{1,9}, ?_2, K_3, g_{10}, \Phi_1, K >,$$

where

$П_и$ - Input ideal (conceptual) domain of the CS;
$З_2$ - The function of recognition of the CS;
$Я_1$ - Natural classification language, which is implemented the classification process;
P_1 - Memory (thesaurus) of the classification system contains the following knowledge:
- Features of homeostatic sets and qualitative assessments;
- Mathematical model of the structure of a homeostatic system;
- Method of metaorganization;

θ_1, θ_9 - the classification operators of feature selection and recognition;
Γ_2 - Morphological type of the space of quality;
K_3 - Cluster type of system classes;
g_{10} - Class-membership function;
$Ф_1$ - The function of quality classification;
K - Space type of classification.

At the stage of the classification system, according to technology of classification, the subject of classification *Sb* determines the class system K_3, which is the basis for the recognition of objects.

Step 1: Determining in the ideal domain of Homeostatics $П_и$ two-dimensional space in the form of a matrix *A* with the size 16×4 (according to the mathematical model), interpreted as a rectangular array of the field elements *J* on which the domains of subjects (X_1), objects (X_2) and control systems ($X_1 \cup X_2$) are allocated, that takes place on the basis of operation of selection of features set *PR* by the operand θ_1 of available in thesaurus P_1, typical for homeostats.

$П_и$: *A*;

A: $16 \times 4 \rightarrow J$;

$X_1, X_2, X_1 \cup X_2 \rightarrow J$:

θ_1: $PR(P_1) \rightarrow A$.

At the stage of the operation of feature selection all the available features are selected.

Step 2: Projection of the two-dimensional space with the selected set of features of homeostats $A(PR(P_1))$ in the quality space Γ with the acquisition of the morphological structure of the quality of classified objects (Γ_2) on the basis of natural language $Я_1$ and the ability of intensionality increasing.

Γ_2: $A(PR(P_1), Я_1) \rightarrow \Gamma$

Step 3: transformation of the morphological space Γ_2 based on class-membership function of homeostatic objects belonging by a set of features to classes g_{10} into the space of a quality classes of the clusters system K_3.
Class-membership function:

$$g_{10} : F(\bigcup_{i=1}^{9} pr_i(Qn)) = (\{Qn_{j|j=1,64} \mid \bigcup_{i=1}^{9} pr_i, Qn_j \in \varnothing, X_1, X_2, X_1 \cup X_2\}),$$

where

$$Qn = (D^m B(\varnothing, CH, PlH, PH, RH, M - FH, I - FH), \{R\oplus, R\otimes, RT\} \subseteq M^n, ((C \subset P) \subset F));$$

pr_i - Feature of homeostat;
Qn_j - Element of the field J;
Ø - Domain of the empty set;
X_1 - Set (domain) of the control subjects;
X_2 - Set (domain) of the control objects;
$X_1 \cup X_2$ - Set (domain) control systems.

The transformation operation:

K_3: $\Gamma_2(g_{10}) \rightarrow K$.

At this step, the space of the quality classes K_3 is filled elementwise by sets of expert assessments of features that defined for the whole dekartian of boolean of the sixth power of the set I on the stage of generating of mathematical model.

Step 4: On the generable classification K the optimization Opt is performed by function of recognition reliability Φ_I of quality of classification based on the input set of classified homeostatic objects. The operator of transformations is θ_9. Operation of the classification K optimization:

$OptK$: $\Phi_I(K_3)$.

The function of recognition reliability of quality:

$$\Phi_1(K_3) : (\bigcup_{i=1}^{9} pr_i(Qn)) \mapsto (\{Qn_{j|j=1,64} \mid \bigcup_{i=1}^{9} pr_i, Qn_j \in \varnothing, X_1, X_2, X_1 \cup X_2\})),$$

$$\theta_9 : \bigcup_{i=1}^{9} pr_i(Qn_j) \mapsto OptK,$$

where

$$\mathrm{Qn} = (\mathrm{D^m B}(\varnothing, \mathrm{CH}, \mathrm{PlH}, \mathrm{PH}, \mathrm{RH}, \mathrm{M - FH}, \mathrm{I - FH}), \{\mathrm{R}\oplus, \mathrm{R}\otimes, \mathrm{RT}\} \subseteq \mathrm{M^n}, ((\mathrm{C} \subset \mathrm{P}) \subset \mathrm{F}))$$

pr_i - Feature of homeostat;
Qn_j - Element of the field J;
Ø - Domain of the empty set;
X_1 - Set (domain) of the control subjects;
X_2 - Set (domain) of the control objects;
$X_1 \cup X_2$ - Set (domain) control systems;
$OptK_3$ - Optimized classification.

As a result, we obtain a formal classification of a set of new structural variants of the pure homeostatic functional fractal systems as a two-dimensional table of the homeostatic network patterns (Table 1).

Table 1: Two-dimensional classification table of homeostatic network patterns

Ø	*R*{M-FH}	*R*{I-FH}	*R*{M-FH, I-FH}
R{CH}	*R*{CH, M-FH }	*R*{CH, I-FH}	*R*{CH, M-FH, I-FH}
R{PlH}	*R*{PlH, M-FH}	*R*{PlH, I-FH}	*R*{PlH, M-FH, I-FH}
R{PH}	*R*{PH, M-FH}	*R*{PH, I-FH}	*R*{PH, M-FH, I-FH}
R{RH}	*R*{RH, M-FH}	*R*{RH, I-FH}	*R*{RH, M-FH, I-FH}
R{CH, PlH}	*R*{CH, PlH, M-FH}	*R*{CH, PlH, I-FH}	*R*{CH, PlH, M-FH, I-FH}
R{CH, PH}	*R*{CH, PH, M-FH}	*R*{CH, PH, I-FH}	*R*{CH, PH, M-FH, I-FH}
R{CH, RH}	*R*{CH, RH, M-FH}	*R*{CH, RH, I-FH}	*R*{CH, RH, M-FH, I-FH}
R{PlH, PH}	*R*{PlH, PH, M-FH}	*R*{PlH, PH, I-FH}	*R*{PlH, PH, M-FH, I-FH}
R{PlH, RH}	*R*{PlH, RH, M-FH}	*R*{PlH, RH, I-FH}	*R*{PlH, RH, M-FH, I-FH}
R{PH, RH}	*R*{PH, RH, M-FH}	*R*{PH, RH, I-FH}	*R*{PH, RH, M-FH, I-FH}
R{CH, PlH, PH}	*R*{CH, PlH, PH, M-FH}	*R*{CH, PlH, PH, I-FH}	*R*{CH, PlH, PH, M-FH, I-FH}
R{CH, PlH, RH}	*R*{CH, PlH, RH, M-FH}	*R*{CH, PlH, RH, I-FH}	*R*{CH, PlH, RH, M-FH, I-FH}
R{CH, PH, RH}	*R*{CH, PH, RH, M-FH}	*R*{CH, PH, RH, I-FH}	*R*{CH, PH, RH, M-FH, I-FH}
R{PlH, PH, RH}	*R*{PlH, PH, RH, M-FH}	*R*{PlH, PH, RH, I-FH}	*R*{PlH, PH, RH, M-FH, I-FH}
R{CH, PlH, PH, RH}	*R*{CH, PlH, PH, RH, M-FH}	*R*{CH, PlH, PH, RH, I-FH}	*R*{CH, PlH, PH, RH, M-FH, I-FH}

RESULTS AND DISCUSSION

Thus, the generated abstract morphological sets of species of homeostatic network structures using the apparatus of stages ontologized as a homeostatic network pattern classification based on the classification system and belonging to the type of homeostatic network. Based on the analysis of the table it can be concluded that the most developed and stable control systems are homeostatic networks, represented by a set of patterns of the last row (green cells), as they observed the most complete sets of sets of homeostats.

Generated classification allows to describe in the shape of homeostatic network patterns already created homeostatic models of the real systems such as the human body, virtual system of artificial autopoietic homeostatic oscillatory neural network and generated extended mathematical model able to describe them as a particular extended set-theoretic models and terms.

For the created homeostatic models describing the human body "Pentacube" and "Hexagon" [9] as for a network system of homeostatic control object S_A represented in the classification by homeostatic pattern $R\{CH, PlH, PH, RH\}$, consisting of four sets of homeostats and the empty set (n = 5) the set-theoretic model has the next appearance:

$$Qn_1 = (R\{CH,PlH,PH,RH\},\{R\oplus,R\otimes,RT\} \subseteq M^5,((C \subset P) \subset F)).$$

Term which describes the species of structure:

$$TR_{Qn_1} = \{\exists d \in (R\{CH,PlH,PH,RH\},\{R\oplus,R\otimes,RT\} \subseteq M^5 \mid d \in D_2\},\forall x \in X_1,\forall y \in X_1,\forall z \in X_1$$
$$((pr_1 d = (x,y))\,\&\,(pr_2 d = z)\,\&\,(\exists a \in X_2(\{(y,a) \in (R\{CH,PlH,PH,RH\},\{R\oplus,R\otimes,RT\} \subseteq M^5 \mid$$
$$d \in D_1\})\,\&\,\{(x,a) \in (R\{CH,PlH,PH,RH\},\{R\oplus,R\otimes,RT\} \subseteq M^5 \mid d \in D_1\}))).$$

For the created meridional model "Merkabah" [9] as for a network system of homeostatic control subject S_B represented in the classification by homeostatic pattern $R\{M\text{-}FH, I\text{-}FH\}$, consisting of two sets of homeostats and the empty set (n = 3) the set-theoretic model has the next appearance:

$$Qn_2 = (R\{M - FH,I - FH\},\{R\oplus,R\otimes,RT\} \subseteq M^3,((C \subset P) \subset F)).$$

Term which describes the species of structure:

$$TR_{Qn_2} = \{\exists d \in (R\{M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^3 \mid d \in D_2\}, \forall x \in X_1, \forall y \in X_1, \forall z \in X_1$$
$$((pr_1 d = (x,y)) \& (pr_2 d = z) \& (\exists a \in X_2(\{(y,a) \in (R\{M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^3 \mid$$
$$d \in D_1\}) \& \{(x,a) \in (R\{M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^3 \mid d \in D_1\}))).$$

For the created meridional-homeostatic model [9] as for a network system of homeostatic control object and subject S_{AB} represented in the classification by homeostatic pattern $R\{CH, PlH, PH, RH, M\text{-}FH, I\text{-}FH\}$, consisting of six sets of homeostats and the empty set (n = 7) the set-theoretic model has the next appearance:

$$Qn_3 = (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7, ((C \subset P) \subset F)).$$

Term which describes the species of structure:

$$TR_{Qn_3} = \{\exists d \in (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7 \mid d \in D_2\},$$
$$\forall x \in X_1, \forall y \in X_1, \forall z \in X_1((pr_1 d = (x,y)) \& (pr_2 d = z) \& (\exists a \in X_2(\{(y,a) \in$$
$$\in (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7 \mid d \in D_1\}) \&$$
$$\& \{(x,a) \in (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7 \mid d \in D_1\}))).$$

For the created model of artificial autopoietic homeostatic oscillator neural network [10] as for a network system of homeostatic control object and subject S_{AB} represented in the classification by homeostatic pattern $R\{CH, PlH, PH, RH, M\text{-}FH, I\text{-}FH\}$, consisting of six sets of homeostats and the empty set (n = 7) the set-theoretic model has the next appearance:

$$Qn_4 = (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7, ((C \subset P) \subset F)).$$

Term which describes the species of structure:

$$TR_{Qn_3} = \{\exists d \in (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7 \mid d \in D_2\},$$
$$\forall x \in X_1, \forall y \in X_1, \forall z \in X_1((pr_1 d = (x,y)) \& (pr_2 d = z) \& (\exists a \in X_2(\{(y,a) \in$$
$$\in (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7 \mid d \in D_1\}) \&$$
$$\& \{(x,a) \in (R\{CH, PlH, PH, RH, M - FH, I - FH\}, \{R\oplus, R\otimes, RT\} \subseteq M^7 \mid d \in D_1\}))).$$

For the created model of homeostatic software as for a network system of homeostatic control object S_A represented in the classification by homeostatic pattern $R\{CH\}$, consisting of 1 set of homeostats and the empty set (n = 2) the set-theoretic model has the next appearance:

$$Qn_6 = (R\{CH\}, \{R\oplus, R\otimes, RT\} \subseteq M^2, ((C \subset P) \subset F)).$$

Term which describes the species of structure:

$$TR_{Qn6} = \{\exists d \in (R\{CH\}, \{R\oplus, R\otimes, RT\} \subseteq M^2 \mid d \in D_2\}, \forall x \in X_1, \forall y \in X_1,$$
$$\forall z \in X_1((pr_1 d = (x,y)) \& (pr_2 d = z) \& (\exists a \in X_2(\{(y,a) \in (R\{CH\}, \{R\oplus, R\otimes, RT\} \subseteq$$
$$\subseteq M^2 \mid d \in D_1\}) \& \{(x,a) \in (R\{CH\}, \{R\oplus, R\otimes, RT\} \subseteq M^2 \mid d \in D_1\}))).$$

Applied component of the research is the ability to design and technical implementation, on the basis of the homeostatic network invariant patterns of natural and artificial homeostatic autopoietic machines [4], high-intelligence complex systems that have all the properties of homeostats and properties of self-controlling and self-creation (realization of full automatic life-cycle). Control of such systems will be based on the scenario approach by strategizing.

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