UDC 007:681:510.2

PROBLEM OF COMPLEXITY IN MODERN CYBERNETICS AND POLYMETRICAL ANALYSIS AS POSSIBLE WAY OF ITS RESOLUTION

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The problem of complexity in modern cybernetics is discussed. This problem must be resolved with help theory with change hierarchy. It was shown that this problem may be resolved with help theory of calculations. Basic peculiarities of polymetric analysis are represented and analyzed too.

Introduction

Problem of complexity is one of central problem in modern science, including mathematics and cybernetics [1 – 12]. This problem is caused in synthetically sciences. Roughly speaking it has two aspects: system (problem of century in cybernetics according S. Beer [1 – 4]) and computational (problem of computational complexity [1, 12]. Last problem is included in basic problems of modern mathematics (Smale problems) [1, 11].

Problem simplicity – complexity is included in Polymetric Aanalysis (PA) (universal system of analysis, synthesis and formalization of knowledge) as principle simplicity.

Hybrid theory of systems (HTS) is created on the basis principles (criteria) of reciprocity and simplicity [1–4]. Only 10 minimal types of formalization system may be used. But number of real systems may be infinite. It is may be represented as answer on the one of basic question of modern theory of systems [1, 7, 8] about possible number of systems and its classification with point of simplicity – complexity [1–4, 9].

Therefore HTS may be represented as variant of resolution the problem of century in cybernetics according S. Beer and may be used for the resolution problem of computational complexity (theory of informative calculations, TIC).

Results and discussions

Polymetric analysis was created as alternative optimal concept to logical, formal and constructive conceptions of modern mathematics and theory of information [1]. This concept is based on the idea of triple minimum.

Basic elements of this theory and their bonds with other science are represented in Figure 1 [1].

Basic mathematical element of polymetric analysis is functional number (generalizing elements of square forms) [1]. As in Greece mathematics number is basic elements of its system. For these numbers generalizing mathematical transformations were constructed. 15 minimal types of its transformations are existed. Informative lattice is constructed on the basis if functional numbers and generalizing mathematical transformations. Theory of informative calculations is created for this lattice. Basic principle of this theory is the principle of optimal calculations.

For classification of systems of calculation hybrid theory of systems was created. This theory is based on two criterions: criterion of reciprocity – principle of creation of proper formal system, and criterion of simplicity – principle of optimality of this creation. For “inner” bond of two elements of informative lattice a parameter

of connectedness was introduced. Principle of optimal informative calculation is included in criterion of simplicity.

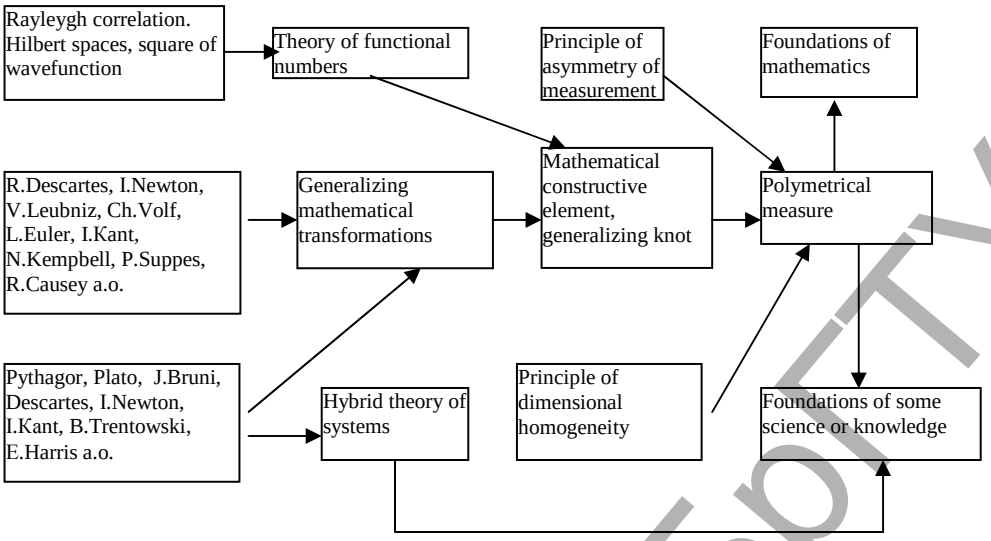

Fig. 1 Schema of polymetric method and its place in modern science [1]

At help these criteria of reciprocity and simplicity and parameter of connectednesss the basic famous parts of knowledge and science may be represent as next 10 types of hybrid systems [1 – 4]:

1. The system with conservation all positions the criteria of reciprocity and simplicity for all elements of mathematical construction ($N_{\varphi_{ij}}$ and transformations) is called the *simple system.*

2. The system with conservation the criterion of simplicity only for $N_{\varphi_{ij}}$ is called the *parametric simple system.*

Remark 1. Further in this classification reminder of criteria of reciprocity and simplicity is absented. It mean that these criteria for next types of hybrid systems are true.

3. The system with conservation the criterion of simplicity only for general mathematical transformations is called *functional simple system.*

4. The system with nonconservation the principle of optimal informative calculation and with $\sigma_t = 1$ is called the *semisimple system.*

5. The system with nonconservation the principle of optimal informative calculation only for $N_{\varphi_{ij}}$ and with $\sigma_t = 1$ is called the *parametric semisimple system.*

6. The system with nonconservation the principle of optimal informative calculation only for general mathematical transformations and with $\sigma_t = 1$ is called the *functional semisimple system.*

7. The system with nonconservation the principle of optimal informative calculation and with $\sigma_t \neq 1$ is called *complicated system.*

8. The system with nonconservation the principle of optimal informative calculation only for $N_{\varphi_{ij}}$ is called *parametric complicated system.*

9. The system with nonconservation the principle of optimal informative calculation only for general mathematical transformations and with $\sigma_t \neq 1$ is called *functional complicated system*.

10. The system with nonconservation the criteriums of reciprocity and simplicity and with $\sigma_t \neq 1$ is called *absolute complicated system*.

With taking into account 15 basic types of generalized mathematical transformations we have 150 types of hybrid systems; practically 150 types the formalization and modeling.

HTS may be used for the classification and creation old and new chapters of computing science.

But four types of these systems aren't mathematical in classical sense [1]. Hybrid theory of systems is open theory. Parameters of openness are number of generalizing mathematical transformations and parameter of connectedness. Thereby we have finite number of types of systems, but number of systems may be infinite. Hybrid theory of systems allows considering verbal and nonverbal knowledge with one point of view [1, 4, 9]. Therefore this theory may be represented as variant of resolution S. Beer centurial problem in cybernetics [1].

TIS may be represented as application PA (HTS) to the problem of calculation [1, 3]. This theory was used for the problem of matrix computation and problem of arrays sorting [1, 3].

TIS may be connected with problem of computational complexity. This problem was appeared in modern cybernetics for resolution of problem the transition from infinite (analytical) to discrete representation of computing procedures [1, 3]. In may be connected with 4 and 5 Smale problems [1,11].

Mathematical constructive element may be represented as generalizing knot of informative lattice. Generalizing mathematical transformations are classified as quantitative and qualitative, left and right. Calculative (quantitative) transformations are corresponded to primary measurement and qualitative transformations – to derived (secondary) measurements. It allows formalizing N.R.Campbell concept [1, 2] about primary and derived measurements. Result of this formalization was named polymetric theory of measure and measurement. Basic principles of this theory are principle of asymmetry of measurement for calculative transformations and principle of dimensional homogeneity. This theory is optimal synthesis of all famous theories of measure and measurements and dimensional analysis [1]. N.R. Campbell concept is more general as "measuring" part of quantum mechanics. Therefore L.I. Mandelstam called Quantum Mechanics as science of derivative measurements [1, 2].

Polymetric analysis is the system of optimal formalization, synthesis and analysis of knowledge. But it is the nature of mathematics [17]. For creation of theory of foundations of mathematics we must include three aspects: synthesis, analysis and formalization. This theory must be open system. Therefore Russel – Whitehead "logic" concept, Hilbert – Bernayce "formal" concept and Brauer – Heiting "constructive" concept can't be full theories of foundations of mathematics [1]. It was cause of crisis in theory of foundations of mathematics. Therefore A.N. Whitehead made conclusion that logical concept can't be the theory of foundations of mathematics [1, 2]. But it must be "organismic" theory. Practically this concept was realized in cybernetics: theory of neuronets, systolic computers, theory of cellular automata a.o. [1]. Therefore polymetric analysis may be represented as variant of realization of Whitehead concept of "organism" mathematics and formalizing unification of proper cybernetic theories (Ivakhnenko concept of neurosets itc.)[1, 7, 8].

Polymetric analysis may be represented as optimal "dynamical' formalization of Errol E. Harris polyphasic concept of modern science [1].

Thus basic concepts of awakening, creation and development of synthesis with including of historical analysis of this problem are represented in [1]. Therefore with this point of view polymetric analysis is the necessary development of problem of formalized synthesis in modern science.

According to A Ershov basic problem of modern computer scince is formalization of phrase of Canadian philosopher L. Hall: “Everything comes from the head – intelligent” [1]. Therefore PA may be represented as optimal formalization of this thesis and, as effect, theoretical basis of modern computing science (informatics) [1, 2].

Conclusions

1. Problem of complexity in modern cybernetics and computing science is discussed.

2. Basic concept and chapters of polymetric analysis are analyzed.

3. It shown, that polymetric analysis is the necessary development of problem of optimal formalized synthesis in modern science.

4. It was shown that HTS may be represented as variant of resolution problem of century in cybernetics according by S. Beer and theory of informative calculations – as variant of resolution of problems of computational complexity.

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