Sumjects and Paradigms, Theory and Applications

Boris Schapiro, mobile +49 172 300 8947, boris@schapiro.org

Andrei Klimov, mobile +7 985 364 3536, klimov@keldysh.ru

In short:

- **Theory of Sumjects and Paradigms is a novel instrument of thinking, which generalizes and reconstructs the concept of name and the concept of concept.**
- **The Theory of Sumjects and Paradigms (TSP) is a phenomenological one. It opens up entirely new possibilities for describing the behavior of complex systems, especially for describing and/or modeling decision-making including decisions about oneself. And for simple systems, it covers the classical, conventional notions.**
- **TSP is applicable, in principle, for solving a large range of practical problems, both qualitatively as well as quantitatively at the level of modeling. The ability to decide about oneself is the basis for the implementation of self-aware machines, self-learning machines with semiotic and semantically capability, and as a further example improved win-win relations between seller and buyer.**
- **Our group of mathematicians and programmers in different countries under the leadership of Dr. Boris Schapiro (totally 17 people) is looking for new partners and financial support for expansion and intensification of the TSP development and its numerous applications.**

Commented content

This document is an extended content of a future book. It is not uniform. Some sections are supplemented by more or less detailed annotations. **The annotations are marked as blue.**

Table of Contents

1 Introduction. International Cooperation in the Development of Theory of Sumjects and Paradigms (TSP) (*A. Klimov*)....2

2 Applications of the Theory....5

3 Main Concepts of Theory of Sumjects and Paradigms....6

3.1 Features....6
3.2 Fundamental processes and their classification....7
3.3 Sumject....7
3.4 Paradigms....8

4 Approaches to the Formalization of Theory of Sumjects and Paradigms....12

5 Conclusion and Prospection....13

6 Bibliography....13

1 Introduction. International Cooperation in the Development of Theory of Sumjects and Paradigms (TSP)

The Theory of Sumjects and Paradigms does not describe the World per se. It describes the perception of the World by a complex observation system. TSP depicts how observers of different complexity and diverse organization levels can see the World and themselves in various contexts. Thus, the Theory of Sumjects and Paradigms is not a theory of the World; it is the theory of knowledge and ability representation.

Whether the results of observations and their interpretations correspond to the World or some aspects of it, and if the observer's behavior is consistent, are decisions by the observer, the interpreter as well as their society.

A group of mathematicians under the leadership of head of sector Andrei Klimov in Keldysh Institute of Applied Mathematics of Russian Academy of Sciences (KIAM RAS), a group in Ailamazyan Program Systems Institute of Russian Academy of Sciences (PSI RAS) under the leadership of its director, corresponding member of RAS Sergei Abramov, and two smaller groups of mathematicians in Berlin and at the University of Ariel, Israel, are working on the development and applications of the Theory of Sumjects and Paradigms (TSP) of Berlin physicist and mathematician Boris Schapiro. Boris Schapiro himself takes part in the project as well.

In terms of Boris Schapiro's Theory of Sumjects and Paradigms, the concepts of sumject and paradigm are a fundamental generalization of the concept of concept and provides a new powerful instrument of thinking and modeling. One of the tasks of this international collaboration is development of new methods and software for modeling and control of complex systems and processes in the frame of TSP.

As early as in the fifth century BC, presocratic philosophers like Parmenides and Zeno discovered that not all phenomena can be expressed in terms of concepts. This especially applies to such complex systems as people and everything that makes decisions about themselves. The paradigms in the sense of Schapiro are very well suited for working with notably such systems as the human, a group of people as well as companies, markets, countries and societies, teaching and self-learning systems, various phenomena of sciences and arts.

The word "paradigm" was brought into modern use by American philosopher of science Thomas S. Kuhn (1922-1996) in 1962. Particularly successful was the use of the concept of a paradigm shift for the description of system revolutions in science and society. However Thomas Kuhn failed to give rigorous content to the very concept of the paradigm. Boris Schapiro succeeded in doing this in 1985.

It is worth to note that Kuhn's concept of a paradigm shift corresponds to the concept of the metasystem transition introduced by Russian physicist and cybernetician Valentin F. Turchin (1931-2010) in the late 1960s. Turchin's book "The phenomenon of science: a cybernetic

approach to human evolution", was prepared for publication by the publishing house "Soviet Russia", but forbidden in 1973 for political reasons, *Turchin, V. 1977.*

The Theory of Sumjects and Paradigms contains several novel categories, some of which have no counterparts in the traditional scientifical and philosophical nomenclature, and are totally absent in the modern worldview. The first one worth noting is a universal classification of processes into synchronous, diachronic and synagone processes. The notions of synchronous and diachronic processes have direct predecessors in linguistics, *Saussure, de F. 1967*. Until the emergence of the Theory of Sumjects and Paradigms, there was no category for synagone processes, even though their phenomena have always existed.

We define the types of processes below, in the corresponding part of the book. As an illustration, we consider a figurative example of a system consisting of many complex subsystems, which participate in the joint behavior. At the behavioral level, the synchronous process is such one, where all participants behave in effigy similar. The diachronic process is the process, in which one or few of participants begin to behave radically elsewise from the majority. The synagone process is such one, in which most of participants change their behavior so that it will be once again synchronous, but corresponding to the novelty introduced by the diachronic process, or they successfully defend themselves against the attempt of innovation.

Another new category is "sumject". The word "sumject" comes from Latin "sum", which means "I am". The sumject is such an entity that can make decisions about it-self. Making a decision about itself includes, of course, executing it, for example, to become someone or something else. If a person is not inherently a slave, he is a sumject. If a company is undergoing a transformation, it is a sumject. When a society such as Russia in the late 80's—early 90's performed "perestroika", it was a sumject. Notice that the result of sumject restructuring does not always agree with the initial goals. The understanding of the sumject nature of self-transformation and that of the processes of its implementation will allow us the better planning decisions about ourselves, to estimate feasibility, as well as to manage these processes.

The Theory of Sumjects and Paradigms is a phenomenological theory. From the paradigmatic perspective, mathematics is an empirical science, and thus belongs to natural sciences like, for example, physics or cybernetics, and merges with them. Thus it makes possible a new approach to the foundations of mathematics. This approach is radically different from the classical Bourbakistic metamathematical attempts to justify mathematics using axiomatically introduced formal languages, and allows us to introduce the model of a mathematician in the mathematics, that of a physicist in the physics and, in general, anyone acting as a sumject into the description and modeling of the activities.

Paradigms in the sense of Schapiro are generative processes producing phenomena, names, concepts, processes, sumjects, and paradigms themselves. The Theory of Sumjects and Paradigms reveals a classification table of paradigm types, according to the three categories of fundamental processes: accordingly synchronous, diachronic and synagone paradigms. There are nine types *(Table 1)* of paradigms in total, where three of them have almost continuous spectrum of subtypes from so-called "big" paradigms to "technologies"; the meaning of the terms will be clarified later.

Currently, 16 researchers totally are working on the project under the leadership of Boris Schapiro: 13 in Russia (5 mathematicians in Keldysh Institute, 7 mathematicians and programmers in Ailamazyan Institute and 1 mathematician in Institute for Design Problems in Microelectronics of RAS), 1 in Israel, and 2 in Germany.

The new instrument of thought — sumjects and paradigms — will allow us to create new information technologies for the development and management of complex systems in the foreseeable future. Boris Schapiro and all participants of the cooperation are sure that innovations based on the Theory of Sumjects and Paradigms will really serve the goodness of humanity as well as each individual in particular. The responsibility for misusing the theory lies, as always, with those who use it.

Moscow, May 24, 2013

Andrei Klimov

Head of Program Analysis and Transformation Sector
Keldysh Institute of Applied Mathematics
Russian Academy of Sciences
http://pat.keldysh.ru/~anklimov
klimov@keldysh.ru
+7 985 364 3536

2 Applications of the Theory

Nowadays, in the field of computer technology, such high processing power has been already achieved, that we often do not even know, how to reasonably apply supercomputers properly and efficiently for which tasks. The Theory of Sumjects and Paradigms is certainly well-suited to guide us in adequate use of massive computing power to solve complex and complicated tasks.

Below we present some of possible applications, which do not exhaust the full range of usefulness of the Theory of Sumjects and Paradigms. It should be noted that most of these applications still need to be developed or created.

Especially, it should be noted that the Theory of Sumjects and Paradigms can be used both qualitatively and quantitatively. The last one still requires an especially great volume of work in the development of the theory and applications. Based on the success already achieved, there is no doubt in the necessity and capability of the theory.

Additionally to development of the new foundations of mathematics as one of the empirical natural sciences, we foresee the following possibilities for successful applications of the Theory of Sumjects and Paradigms (TSP):

2.1 Improvement of interaction of salespeople and customers, amplification of mutual benefits of vendors and clients, namely:
- 2.1.1 prediction and recognition of appearance of new fashion of goods, styles and behaviors
- 2.1.2 modeling of archetypical behavior of customers
- 2.1.3 and in general, optimization of zero-sum games of any kind

2.2 Control of complex systems:
- 2.2.1 modeling, prediction and early recognition of chaotization of complex systems
- 2.2.2 prevention of chaotic behavior of complex systems as much as it is possible in principle
- 2.2.3 control of large power grids and other systems with network structure

2.3 Information technology:
- 2.3.1 control of distributed concurrent computation in supercomputers and computer grids
- 2.3.2 methods of programming, metacomputation, supercompilation *etc*., *Turchin, V. 1986; Glück, R., Klimov, A. 1994; Abramov, S., Parmenova, L. 2006*
- 2.3.3 human-machine interaction
  - 2.3.3.1 The Theory of Sumjects and Paradigms provides new possibilities for informational definition of both human and machine, and for distinguishing between them, as well as for optimization of interaction of them. Thus, we see new approaches to solving the classical Artificial Intelligence problem, namely the Turing test, *Turing, A. 1950*

2.4 Applications of TSP at qualitative level:
- 2.4.1 assistance in optimization of project-, management- and other administration tasks

2.4.2 analysis of strategic and tactical problems and perspectives in social, economic, and notably political life
2.4.3 optimization of medical diagnostics and treatment
2.4.4 planning of education, family, career
2.4.5 and many more

2.5 Applications of TSP at qualitative and quantitative level:
2.5.1 sumject-oriented micro-economical strategies
2.5.2 sumject-oriented macro-economical strategies
2.5.3 sumject-oriented modeling, if possible, of political and diplomatic games, including elections games
2.5.4 sumject-oriented military analysis in strategy, tactics and military-economical interaction, *Thomas, Th. 2004*

2.6 Application of the Theory of Sumjects and Paradigms (TSP) in the evolution of other sciences and of the scientific and philosophical image of the world:
2.6.1 sumject-oriented Physics of Complexity, Cognition and Artificial Intelligence
2.6.2 the new criticism of Bourbakism
2.6.3 sumject-oriented paradigmatical Linguistics
2.6.4 paradigmatical Literary Studies
2.6.5 sumject-oriented Rational Theology, universal foundations of the relationship between knowledge, belief and might, as well as metaphysics and confessional organization of specific religious communities
2.6.6 sumject-oriented universal, as well as domain-specific Ethics
2.6.7 paradigmatical jurisprudence and sumject-oriented cultural and historical contexts of law court and lawyer's practice
2.6.8 sumject-oriented Psychology
2.6.9 sumject-oriented Psychiatry
2.6.10 sumject-oriented Holistic Medicine
2.6.11 and many others

3 Main Concepts of Theory of Sumjects and Paradigms

3.1 Features

3.1.1 Generation of features

3.1.2 Metrization of features

3.1.3 The feature space

3.1.4 Processes as movement in the feature space

3.1.5 Similarity of features, a similarity cluster
3.1.5.1 sequences of feature clusters, the limits of the sequences of feature clusters
3.1.5.2 equivalence classes as limits of feature clusters

3.1.6 Relationships between the traditional areas of knowledge (physics, mathematics, cybernetics) and the Theory of Sumjects and Paradigms

3.2 Fundamental processes and their classification

3.2.1 Types of fundamental processes
- 3.2.1.1 synchronous processes
- 3.2.1.2 diachronic processes
- 3.2.1.3 synagone processes

3.2.2 Trajectories in the feature spaces, interface and interplay of processes

3.2.3 Examples
- 3.2.3.1 evolution
- 3.2.3.2 management
- 3.2.3.3 relationships in teams
- 3.2.3.4 customer-vendor relationships
  - 3.2.3.4.1 zero-sum games, the primitive conceptions of life
  - 3.2.3.4.2 negative-sum games, war, crime, stupidity, irresponsibility
  - 3.2.3.4.3 positive-sum games, family, education, charity, justice, social welfare, sciences, literature, art, and others

3.3 Sumject

3.3.1 The concept of a phenomenon

3.3.2 The concept of context, context dependency, the possibility of neglecting some aspects of the context depending on the intentions of the observer, the idealization

3.3.3 The observer, observation as activity
- 3.3.3.1 common myths: in the classical descriptions, the observer is as though "not involved" in the behavior of a system observed: mathematician is "not involved" in mathematical theory, physicist is "not involved" in physical models, programmer is "not involved" in program execution

3.3.4 The subject and the object as roles in hierarchical interaction
- 3.3.4.1 fundamental criticism: in all practiced approaches, the decisions of an active entity about itself are not separated as an outstanding process
- 3.3.4.2 the understanding of the participation in activities without violence, thus on a voluntary basis

3.3.5 Sumject is a fundamentally new concept for an entity with free will and, therefore, capable of making non-trivial decisions about itself

3.3.6 Modeling of the sumject
- 3.3.6.1 when and where the sumject does not make decisions about himself, the modeling of him as an individual is possible
- 3.3.6.2 then and there it is either an object or a subject (makes decisions about others)
- 3.3.6.3 then and there the dynamic description of the subject as managing system and the object as managed one is possible, and interaction of subjects can be described in terms of the Theory of Conflicting Structures by Vladimir Lefebvre, *Lefebvre, V. 1967; Lefebvre, V. 1982; Thomas, Th. 2004*
- 3.3.6.4 when a sumject does not make decisions about himself, then both his individual behavior and the ensemble of behaviors can be modeled on the basis of dynamic and/or statistical description of subjects and objects; that is important for applications

3.3.6.5 when a sumject makes non-trivial decisions about himself and thus generates unpredictable behavior, the deterministic modeling of his behavior at the individual level is fundamentally impossible

3.3.6.6 however, even in this case, study and classification of archetypical behavior of sumjects taking non-trivial decisions about themselves are possible. In this situation, although some sumjects remain unpredictable, the Theory of Sumjects and Paradigms allows us to predict and even to model the probability distribution of behavioral acts of sumjects, if their archetypes can be studied on sufficiently large statistics of behavioral features. This is mainly important for a number of applications, especially in order to understand the archetypical interaction of sumjects.

3.4 Paradigms

Paradigms are generative processes that can produce phenomena, names, concepts, processes, sumjects, as well as paradigms themselves.

3.4.1 Types of paradigms
- 3.4.1.1 minimal paradigm
- 3.4.1.2 small paradigm
- 3.4.1.3 big paradigm
- 3.4.1.4 spectrum of big paradigms from a minimally big one to a technology

3.4.2 Archetypes of paradigms in correspondence to the classification of fundamental process
- 3.4.2.1 synchronous paradigms
- 3.4.2.2 diachronic paradigms
- 3.4.2.3 synagone paradigms
- 3.4.2.4 classification of paradigm archetypes *(Table 1)*

3.4.3 Interaction of paradigms

3.4.4 Paradigms and sumjects

3.4.5 Paradigms as an instrument of thinking
- 3.4.5.1 names *(Table 2)* Phenomena can have several names. A name can refer to several phenomena. Some names exist without phenomenon. Some phenomena can have no name. Some names can be sacral and not allowed for use.
  - 3.4.5.1.1 name of a phenomenon
  - 3.4.5.1.2 name of a name
  - 3.4.5.1.3 name of a concept
  - 3.4.5.1.4 name of processes
  - 3.4.5.1.5 name of a paradigm
- 3.4.5.2 concepts: organization of “clusters”, domains in the feature space with fuzzy edges
  - 3.4.5.2.1 minimal paradigm allows to recognize whether an entity belongs to the cluster
  - 3.4.5.2.2 small paradigm: how “well” does an entity belong to the cluster?
  - 3.4.5.2.3 concept of a name
  - 3.4.5.2.4 concept of a concept
  - 3.4.5.2.5 concept of processes
  - 3.4.5.2.6 concept of a paradigm

Table 1. Matrix of paradigmatic archetypes, which is on its part the representation of the paradigm of paradigms.

Kind of Paradigm / Type of process	**Minimal paradigm**	**Small paradigm**	**Big paradigm**	**Complete paradigm or Technology**
Synchronous processes	Minimal synchronous paradigm: ***Representation*** of *events and phenomena*	Small synchronous paradigm: ***Metarepresentation*** of events and phenomena	Big synchronous paradigm: ***Creation*** of events and phenomena	Complete synchronous paradigm: ***Production*** of events and phenomena
Diachronic processes	Minimal diachronic paradigm: ***Representation*** of new synchronous paradigm	Small diachronic paradigm: ***Metarepresentation*** of *new synchronous paradigm*	Big diachronic paradigm: ***Creation*** of new synchronous paradigm	Complete diachronic paradigm: ***Production*** of new synchronous paradigm
Synagone processes	Minimal synagone paradigm: ***Representation*** of the implementation of new synchronous paradigm	Small synagone paradigm: ***Metarepresentation*** of the implementation of new synchronous paradigm	Big synagone paradigm: ***Creation*** of *the implementation of new synchronous paradigm*	Complete synagone paradigm: ***Production*** of the implementation of new synchronous paradigm

Table 2. Illustration of the correspondence between names and phenomena

	Name 1	Name 2	Name 3	Name 4	Name 5
Phenomenon 1	X				
Phenomenon 2					X
Phenomenon 3					X
Phenomenon 4		X			
Phenomenon 5			X		X
Phenomenon 6					
Phenomenon 7		X			

3.4.5.3 paradigm: an action that is a training example for the ancient Greeks, while for us it is any action carried out by any rules, e.g., the rules of correspondence of the actions to desired results
3.4.5.3.1 paradigm of phenomena
3.4.5.3.2 paradigm of names
3.4.5.3.3 paradigm of concepts
3.4.5.3.4 paradigm of processes
3.4.5.3.5 paradigm of sumjects
3.4.5.3.6 paradigm of paradigms
3.4.5.3.6.1 The paradigm of all paradigms is a consistent concept, because the concept of a paradigm is based on the concept of similarity cluster, which, generally speaking, turns in the extreme case into the concept of an equivalence class. It is well known that the concept of the class of all classes is consistent (in contrast to the concept of the set of all sets). Furthermore, paradigms are actions and thus are not limited to static structures such as sets. We expect, in this connection, that the concept of a cluster of all clusters would be consistent in the same sense in which the concept of the class of all classes is consistent. These two considerations outline the way of proving the consistency of the concept of the paradigm of all paradigms
3.4.5.4 paradigms distinguish by the answer to the following questions:
3.4.5.4.1 "Do I do what I want?" — the minimal paradigm of paradigms
3.4.5.4.2 "Do I do well what I want?" — the small paradigm of paradigms
3.4.5.4.3 "How well is what I do reproducible?" — the big paradigm of paradigms
3.4.5.4.4 If it is reproducible very well, then we deal with a technology; if just producible somehow, then we deal with just a big paradigm

3.4.6 A paradigm is always an action
3.4.6.1 paradigm as an action can contain:
3.4.6.1.1 phenomenon
3.4.6.1.2 name
3.4.6.1.3 name and a concept
3.4.6.1.4 concept (without name)
3.4.6.1.5 paradigm (with a name, with a concept, or without both)
3.4.6.2 an example: the tango dance
3.4.6.2.1 "tango" is the name of the dance
3.4.6.2.2 descriptions of the tango dance at various levels of detail are the concepts of the tango dance
3.4.6.2.3 the paradigm of tango is dancing tango
3.4.6.2.4 teaching somebody to dance tango is possible only by transferring the paradigm of tango, but it is impossible at the level of the name, and it can be done only with great difficulties at the level of the concept
3.4.6.3 Paradigms are typical phenomena in the education of the younger generation in the animal world with the principle of "do as I do"

3.4.7 The evolution of paradigms

3.4.8 Relationships of paradigms with Physics and Mathematics

3.4.8.1 Paradigms are actions; actions may be “right” or “wrong”; the right actions correspond to the similarity clusters of paradigms. The wrong ones correspond to the paradigms that do not belong to the related cluster

3.4.8.1.1 Example: the beloved is never “wrong”; nothing in the world is perfect apart from the beloved

3.4.8.1.2 Sometimes we see that the recognition paradigm of the loving sumject (initially synchronous) get a diachronic impulse of frustration, and, as a result, he goes through a very painful synagone process to the new synchronous process of being, in which the earlier object of love is not more perfect

3.4.8.2 Paradigms must carry out in space and time, in the circumstances of preserving energy, momentum, angular momentum, and other restrictions corresponding to the laws of physics, chemistry, biology *etc*.

3.4.8.3 In the TSP, the observer as well as the agent (the one who performs the action) both are included in the model that describes the entire range of phenomena

3.4.8.4 The TSP is a phenomenological theory, which describes systems of very high complexity just because it concerns, among other things, the description and simulation of sumjects

3.4.8.5 Complex systems imply memory and the memory of the memory, as well as the memory of the memory of the memory *etc*., which is consistent with the Theory of Conflicting Structures by Vladimir Lefebvre, *Lefebvre, V. 1967*

3.4.8.6 The following two types of limit passages are possible in actions carried out by the corresponding paradigms:

3.4.8.6.1 the first one is performing repeated actions, ordered by the degree of compliance of these very actions with the desired result specified by the allowable domain in the concept of the result

3.4.8.6.1.1 if we talk about the relationship of the result of the actions with the domain of the concept of the goal or the result in the feature space, we see the correspondence of this ordering to the epsilon-delta language of the Function Theory

3.4.8.6.1.2 actions are ordered by clusters of trajectories, which we call “tubes” in the feature space, in which they are carried out

3.4.8.6.2 the second one is that actions relate to the recognition of the sumject himself, who performs the actions recursively

3.4.8.6.2.1 This recursion may converge (or not) to such a form where the next step does not provide any new information. If this happens, the system of representation of knowledge or observation in sumject’s memory (or subject’s) becomes a fractal

3.4.8.7 Our mental representations about the limits of both these processes are actually the minimal paradigms that distinguish the goals of the actions from all other phenomena of the world. Such minimal paradigms correspond to the definitions in the common mathematical sense, when separation of the defined object from all other phenomena of the world is without any doubt

3.4.8.8 In the same sense, all phenomena of mathematics, including definitions, derivations, logical connectives, proofs and axioms, become the limiting actions in the sumject’s activity represented in his memory and consciousness.

Thus, we see and we are going to justify in detail that mathematics in the sense of the Theory of Sumjects and Paradigms is a system of limiting relations in the mind of a mathematician-sumject. He acts upon empirical events and their representations in the sumject's consciousness

3.4.9 Relationship of paradigms with Epistemology and Philosophy of Science

3.4.9.1 paradigms and semiotics, *Schapiro, B., Schapiro, H. 2009a*, short version; *Schapiro, B., Schapiro, H. 2009b*, long version

3.4.9.2 paradigms and semantics

3.4.9.3 paradigms and logics and its generalizations, Goedel's theorems and related problems, the impossibility of foundations of mathematics without an active sumject in the role of the mathematician

3.4.9.4 relationships of paradigms with famous mistakes and misapprehensions in sciences and theory of science

3.4.9.5 paradigms and history of philosophical views and apprenticeships about the being

3.4.9.6 and much more

4 Approaches to the Formalization of Theory of Sumjects and Paradigms

The Theory of Sumjects and Paradigms will be formalized with the use, among others, of the following methods and approaches:

4.1 Methods of theoretical physics

4.1.1 the theory of information and statistical physics

4.1.2 the theory of non-stationary processes

4.1.3 the theory of complexity measure by Boris Schapiro, *Guenther, R. et. al., 1996; Guenther, R. et. al., 1992; Guenther, R. et. al., 1994; Levitin, L. et. al. 1996; Luelsdorff, Ph., Schapiro, B. 1991; Schapiro, B. 1994; Schapiro, B., Schapiro, H. 1998; Schapiro, B. 2007*

4.1.4 nonlinear dynamics and the theory of dynamical chaos

4.1.5 our generalization of mathematical apparatus of second quantization by Berezin & Fock, which will become one of the main methods of mathematical description of sumjects in the context of their activity, by means of generalized creation and annihilation operators in the space of features, *Berezin, F. 1965; Berezin, F. 1983; Berezin, F. 1987; Schapiro, B. 1979; Schapiro, B. 1981*

4.2 Methods of cybernetics and computer science

4.2.1 Metasystem Transition Theory by Valentin Turchin, *Turchin, V. 1977; Glück, R., Klimov, A. 1995*

4.2.2 Cybernetic Foundations of Mathematics by Valentin Turchin, *Turchin, V. 1983; Turchin, V. 1987*

4.2.3 Metacomputation and Supercompilation, *Turchin, V. 1986; Glück, R., Klimov, A. 1994*

4.2.4 Theory of Conflicting Structures and Theory of Reflexive Control by Vladimir Lefebvre, *Lefebvre, V. 1967; Lefebvre, V. 1982; Thomas, Th. 2004*

5 Conclusion and Prospection

6 Bibliography

Abramov, S., Parmenova, L. 2006, S.M. Abramov, L.V. Parmenova, Metacomputation and its Application. Supercompilation. (Metavychisleniya i ikh primenenie. Superkompiliatciia). University of Pereslavl Publisher, Russia, 2006. (Russ.) http://window.edu.ru/resource/721/41721

Berezin, F. 1965, F.A. Berezin, *The Method of Second Quantization*. Nauka Publisher, Moscow, Russia, 1965. (Russ.). Academic Press, 1966. (Eng.) http://www.amazon.com/Quantization-Monographs-Textbooks-Applied-Physics/dp/0120894505

Berezin, F. 1983, F.A. Berezin, *Introduction to algebra and analysis with anticommutating variables (Vvedenie v algebru i analiz s antikommutiruyushchimi peremennymi)*. Moscow: MGU Publisher, 1983. (Russ.) http://www.ozon.ru/context/detail/id/19715392/ http://bookre.org/reader?file=587415

Berezin, F. 1987, F.A. Berezin, *Introduction to Superanalysis*, Springer, 1987. http://link.springer.com/book/10.1007/978-94-017-1963-6

Glück, R., Klimov, A. 1994, Robert Glück and Andrei Klimov, Metacomputation as a tool for formal linguistic modeling. In: R. Trappl (ed.), *Cybernetics and Systems '94*, Vol.2, pages 1563–1570. World Scientific Pub. Co., Singapore, 1994. http://pat.keldysh.ru/~anklimov/papers/1994.Metacomputation.as.a.Tool.for.Formal.Linguistic.Modeling.pdf

Glück, R., Klimov, A. 1995, Robert Glück and Andrei Klimov, Metasystem transition schemes in computer science and mathematics. *World Futures: the Journal of General Evolution* 45, pages 213–243, 1995. ftp://ftp.vub.ac.be/pub/projects/Principia_Cybernetica/WF-issue/Glueck&Klimov.rtf

Guenther, R. et. al., 1992, Guenther, R., Schapiro, B. and Wagner, P., Physical Complexity and Zipf's Law. *Int. J. Theor. Phys*., 31, 525–543, 1992. http://link.springer.com/article/10.1007%2FBF00740003

Guenther, R. et. al., 1994, Guenther, R., Schapiro, B., Wagner, P., Complex Systems, Complexity Measures, Grammars and Model-Inferring. *Chaos, Solitons & Fractals*, 4, 635–651, 1994. http://www.sciencedirect.com/science/article/pii/0960077994900728

Guenther, R. et. al., 1996, R. Guenther, L. Levitin, B. Schapiro, P. Wagner, Zipf's Law and the Effect of Ranking on Probability Distributions, *International Journal of Theoretical Physics*, 35, 395–417. 1996. https://getinfo.de/app/Zipf-s-Law-and-the-Effect-of-Ranking-on-Probability/id/BLSE%3ARN003578215

Lefebvre, V. 1967, Vladimir Lefebvre, *Conflicting Structures (Konfliktuyushchie struktury)*. Moscow: Vysshaya Shkola, 1967. (Russ.)
http://314159.ru/lefebvre/lefebvre1.htm
http://bookre.org/reader?file=475460

Lefebvre, V. 1982, Vladimir Lefebvre, *Algebra of Conscience*, Springer, 1982.
http://www.amazon.com/Algebra-Conscience-Theory-Decision-Library/dp/0792371216
http://link.springer.com/book/10.1007/978-94-010-9051-3

Levitin, L. et. al. 1996, L. Levitin, B. Schapiro, L. Perlovsky, The Zipf Law Revisited: An Evolutionary Model of Emerging Classification, *Proceedings of the NIST Intelligent Systems Conference*, Oct. 20–23, 1996, Gaithersburg, MD (USA).
http://www.researchgate.net/publication/232318125_The_Zipf_law_revisited/file/79e415081e455aa396.pdf

Luelsdorff, Ph., Schapiro, B. 1991, Ph. Luelsdorff, B. Schapiro, Parameters of Orthography, *Theoretical Linguistics*, 17: 203–230, 1991.
http://dx.doi.org/10.1515%2fthli.1991.17.1-3.203

Saussure, de F. 1967, Ferdinand de Saussure (1857–1913), *Grundfragen der allgemeinen Sprachwissenschaft*, de Gruyter Studienbuch, 1967.
http://www.amazon.de/Grundfragen-allgemeinen-Sprachwissenschaft-Gruyter-Studienbuch/dp/3110170159#reader_3110170159

Schapiro, B. 1979, Boris Schapiro, *Raman-Effekt bei flachen Makromolekuelen unter Beruecksichtigung einer Paarkorrelation zwischen pi-Elektronen*, PhD Thesis. Tuebingen, 1979.
http://www.worldcat.org/title/raman-effekt-bei-flachen-makromolekulen-unter-berucksichtigung-einer-paarkorrelation-zwischen-pi-elektronen/oclc/256211671

Schapiro, B. 1981, Boris Schapiro, About an Adiabatic Theory. *Zeitschrift für Naturforschung, Section A-A, Journal of Physical Sciences* 36 (5): 516–518, 1981.
http://adsabs.harvard.edu/abs/1981ZNatA..36..516S

Schapiro, B. 1994, Boris Schapiro, An Approach to the Physics of Complexity. *Chaos, Solitons & Fractals* Vol. 4, No.1, pp. 115–123, 1994.
http://www.sciencedirect.com/science/article/pii/0960077994900213

Schapiro, B. 2007, Boris Schapiro, The fake of a cemetery. Section: Elements of Conception of the World. *Neva*, 2007 Nr. 5. (Russ.)
http://magazines.russ.ru/neva/2007/5/sh12.html

Schapiro, B., Schapiro, H. 1998, Boris Schapiro, Hella Schapiro, Begriff der Mentalitaet und Konzeption des Menschen. In: *Neue Lernverfahren*, Ed.: Hans G. Klinzing, DGVT-Verlag, Tuebingen 1998, pp. 41–48.
http://d-nb.info/955311837/04

Schapiro, B., Schapiro, H. 2009a, Boris Schapiro, Hella Schapiro, Metarepresentations and Paradigms (short version), Wildgen, Wolfgang / Heusden, Barend van (eds.) *Metarepresentation, Self-Organization and Art,* Bern, Berlin, Bruxelles, Frankfurt am Main, New York, Oxford, Wien, 2009. 298 pp., 18 ill., 62 tables and graphs. European Semiotics: Language, Cognition, and Culture. Vol. 9, Edited by Per Aage Brandt, Wolfgang Wildgen and Barend van Heusden: https://docs.google.com/a/schapiro.org/viewer?a=v&pid=sites&srcid=c2NoYXBpcm8ub3JnfHd3d3xneDo3ODNjNjc0ZGJmZTI5MzBi

Schapiro, B., Schapiro, H. 2009b, Boris Schapiro, Hella Schapiro, Metarepresentations and Paradigms (long version): https://docs.google.com/a/schapiro.org/viewer?a=v&pid=sites&srcid=c2NoYXBpcm8ub3JnfHd3d3xneDo1NzY2MTBlYjc3ZDkwYzlk

Thomas, Th. 2004, Timothy Thomas, Russia's Reflexive Control Theory and the Military. *Journal of Slavic Military Studies* 17: 237–256, 2004. http://www.rit.edu/~w-cmmc/literature/Thomas_2004.pdf

Turchin, V. 1977, Valentin Turchin, *The Phenomenon of Science: A Cybernetic Approach to Human Evolution*. New York: Columbia University Press, 1977. http://www.amazon.com/The-Phenomenon-Science-Cybernetic-Evolution/dp/0231039832 http://pespmc1.vub.ac.be/POS/TurPOS-prev.pdf

Turchin, V. 1983, Valentin Turchin, *The Cybernetic Foundation of Mathematics*. The City College of the City University of New York, 1983. http://bookre.org/reader?file=559874

Turchin, V. 1986, Valentin Turchin, The concept of a supercompiler. *ACM Transactions on Programming Languages and Systems* 8, N 3, 1986, pp. 292–325. http://dx.doi.org/10.1145/5956.5957

Turchin, V. 1987, Valentin Turchin, A Constructive Interpretation of the Full Set Theory. *The Journal of Symbolic Logic*, Volume 52, Issue 1, 1987, pp. 172–201. http://www.jstor.org/discover/10.2307/2273872

Turing, A. 1950, Alan Turing, Computing Machinery and Intelligence. *Mind* LIX (236): 433–460, October 1950. http://www.csee.umbc.edu/courses/471/papers/turing.pdf