Iurii Teslia

NON-FORCEFUL NATURE

Monograph

Cherkasy-2014

Recommended by the Academic Council
of Kiev National University of Construction and Architecture,
the dated January 29, 2010

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Non-forceful Nature: Monograph / I. N. Teslia. – Cherkasy : Chabanenko Y. A., 2014. – 176 p.

ISBN 978-966-493-856-0

The work is based on the assumption that there are only non-forceful interactions in Nature which are caused by informational reasons, and their laws are the same at all levels of organization of matter. At this, the motion of any material objects is formed by their internal organisation (the essence, its own functionality) – their introformation. Using the laws of motion as implemented information processor of Nature, the system of models and methods of changing of internal structure of natural and artificial intelligence systems in the processes of non-forceful interaction was developed. Their experimental verification was carried out and the algorithms of the systems natural-language access to databases, prediction of sports games results, evaluation of investment proposals, assessment and prediction of risk of disease based on the introformational interpretation of physical laws were introduced.

It is recommended to scientists who study philosophic, natural-science or technical aspects of existence of the system of information in Nature and for professionals engaged in developing the artificial intelligence systems.

У основі роботи лежить припущення про те, що всі взаємодії в Природі обумовлені інформаційними причинами, і їх закони єдині на всіх рівнях організації матерії. Тому несилова (інформаційна) взаємодія людини повинна мати аналог і на мікрорівні Природи. Для доказу цього було показано, що представлення руху через внутрішню (інтроформаційну) функціональність матеріальних утворень значно спрощує, пояснює і робить розумними ряд фізичних законів. Введення такої внутрішньої функціональності у формули фізичних законів, дозволило побудувати математичну модель, що описує можливий алгоритм функціонування інформаційного процесора Природи на різних рівнях організації матерії.

Проведено експериментальні дослідження, що продемонстрували адекватність отриманих виразів процесам в областях інтелектуальної діяльності людини. Наведено методи побудови і алгоритми систем природно-мовного доступу до баз даних, прогнозування результатів спортивних ігор, оцінки інвестиційних пропозицій, оцінки і прогнозування ризиків захворювань, що базуються на інформаційній інтерпретації законів взаємодії.

Поєднання в роботі фізичних законів з передбачуваною інформаційною першопричиною прояву матеріальних утворень дозволило формалізувати і об'єднати фізичні і інформаційні аспекти буття через призму загальності законів несилової взаємодії в Природі.

ISBN 978-966-493-856-0

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In the beginning was the word.
And the word was with God.
And the word was God
The Gospel of John

PREFACE

We often hear: “In the beginning was the word...” (The Gospel of John). But we seldom think over the materialistic sense of this quote. If the word (information) is in the beginning of everything, then certain informational Beginning should be manifested in the Laws of nature! In other words, physical laws must “reflect” more general, for Nature, laws of transformation of its informational content. The question arises. What should the functioning mechanism of the “informational processor of Nature” be to receive the existing laws of physics? In the monograph the search for an answer to this question is conducted from the positions of natural science, based on the simple Idea which fundamentally changes everything. The movement in Nature is not specified by external “forceful coercion” but by “internal functionality “ of any material entities (objects) that reflects the reflexes of the matter developed for 13.7 billion years and “knows” how to produce a response (movement) to the non-forceful (informational) impact of other entities (which in such a field model form gravitational, electromagnetic, weak and strong nuclear interactions – information media). Hereof it follows that: informational causes lie in the basis of interactions which are at the moment understood as forceful interactions; “internal functionality” of the material objects is in the basis of motion; non-forceful interactions are characteristic not only for the animate, but also for inanimate objects and their laws are universal at every level of existence of the matter.

Perhaps these ideas will not be accepted by everybody. Many will say that the work is too ambitious and pretentious. But everybody has his/her own mission in the Universe. My name is Teslia (a carpenter in Ukrain-

ian), and I was born on Christmas Day?! Maybe there is some sign here and the promotion of the ideas outlined in the monograph is my mission? At least I know that Nature is based on the non-forceful interactions (as it should be in the society) and I have no doubt that the ideas of the monograph will sooner or later be accepted in the science which has learnt the laws of creation the information foundation of the Universe.

Not everything is done of what was planned. And the respected scientists will probably have questions and comments to the representation of the material. But it is impossible to reflect the whole immensity of the subject in one work. The longest road starts with the first step. I hope that my research will encourage You, dear reader, to make next steps in this direction.

I want to thank all those who directly or indirectly helped me in my academic life. This monograph would never appear, if I did not have such beautiful and intelligent wife – Olga. Her support is apparent in everything. The first is that she always knows when to agree and when to disagree with me. An important role was played by my family – daughters Eugene and Natasha, their husbands – Dima and Alexey, granddaughter Sasha and grandson Alex. I am grateful for the talent I have not only to my parents, now deceased, Raisa Yakovlevna and Nikolay Fedotovich, but also to my grandparents, who raised me, – Berdnik Yaakov Denisovich and Berdnik Vera Ivanovna. I will never forget teachers who cultivated the love to physics in me – Galina Danilovna Tkach and Nicholay Panteleymonovich Morgun, who managed to instill in me an everlasting love to science. For the love to informatics and for my formation as a scientist I am grateful to my scientific supervisor Bushuyev Sergei Dmitrievich. Nikolai Mikhailovich Denisenkov, my student friend, pushed me to search for the solutions of the ambitious task outlined in this monograph. Great help in creating the conditions for the normal scientific work all these years was given to me by my friends – Goncharuk Volodya and Luda, Dvoretsky Nicholay and Tanya, Zhurba Shura and Luda, Ivashin Oleg and Luba, my school friend Nikolay Kravchenko and his wife Lily, Malye Alexander and Nadezhda, Samarkin Volodya and Zoia. I have always worked in organizations that were headed by wonderful leaders. And I thank them for the conditions they created for my work. This is the head of the construction of the South – Ukrainian NPP Stulin Nicholay Konstantinovich, The Principle of Cherkassy State Technological University Lega Yuriy Grigorievich, the Principle of the Kiev National University of Construction and Architecture Tuqay Anatoly Mikhailovich, Smirnov Vyacheslav Nikolaevich. Excellent working conditions are created for me now at the Kiev National Taras Shevchenko University. For this I am grateful to the principle of the University Guberskiy Leonid Vasilievich, first Deputy Principle Zakusilo Oleg Kalenikovich, my friend Komzyuk Leonid Trofimovitch and my fellow countryman Ivan Sergeyevich Gritsenko. I was pleased to work under the direct management of my senior colleagues. These are Mikhailov Vitaly Sergeevich, Lyanko Stanislav Dmitrievich, Timchenko Anatoly Anastasevich, Oleinik Gregoriy Timofeivich, Salapatov Vladimir Ivanovich, Solovyov Vladimir Nikolaevich, Polshakov Valeriy Ivanovich, Zadorov Vyacheslav Borisovich, Stepura Alexander Vladimirovich, Chernetzky Sergei Grigorievich. Great work on the preparation of this monograph was made by the translators Kurilko Oksana, Sinitsa Vladislav, Kucherenko Mariana and Rych Marina. Special thanks for the support in my research to the famous scientists Palagin Alexander Vasilievich, Vasilyev Vsevolod Victorovich, Burkov Vladimir Nikolaevich, Husak Andrei Mikhailovich, Rach Valentin Anatolevich, Kuzmuk Valery Valentinovich, Trius Yuri Vasilievich, Shcherbina Alexander Andreyevich, Vishnyakov Alexander Michailovich, Pilipenko Valery and especially Popovich Natalia Leontievna, who accepted the heavy burden of the popularization of my theory in western countries. Thanks to my talented pupils Kayuk Paul, Beloschitskiy Andrei, Timinskiy Alexander, Voitenko Alexander, Oberemko Ivan, Kucherenko Alexander, Chorniy Alexander and Irina, Bezmogorychny Dmitri, Chuprina Christina, Chaika Andrey and Kubyavka Lyubov. Without those who believed in me, who helped me, this monograph would never have appeared.

I am very grateful to everyone who helped me to do my work.

Iurii Teslia

Dedicated to the manager
of this project –
my darling wife Olya

INTRODUCTION

The development of informatics as a science about information processes and systems in the surrounding world caused the rapid development of those areas of natural and test activities which use to one or another extend the theoretical and practical results of research of information as some universal property of Nature. But the lack of natural-science foundation in the works on informatics leads to the formation of scientific base of disciplines which are related to this area of researches through the prism of "human" vision of information and processes of its transformation. As if it is done of the will and in accordance with the mechanism of its generation and use developed by the humanity and not as the result of implementation of the fundamental, objectively existing, differently understood, but nevertheless common, laws of information transformation in the interaction processes in Nature.

Further development of theoretical foundations of informatics should be connected to the structural representation of information in natural systems, investigation of the mechanism of interaction of the elements of these systems with the implementation of the procedures of information transformation in the certain abstract and possibly real (in the author's opinion) informational processor of Nature. There arises the scientific problem which lies in the need of elaboration of common, including physical and informational components, outlook on the essence of the laws of Nature. The problem of the investigation is caused by the weak development of natural science foundations of sciences about information and altogether by the lack of common views on the content and role of essence which is hidden behind the notion of information in Nature. As a result, the works in the field of theoretical foundations of informatics have the applied, artificial (not natural) scientific nature, are based on the understanding rather than on the knowledge of essence of information in Nature and express the attitude of the human intellect towards the natural environment, and not Nature of human intellect in respect to the objectively existing laws.

The author has formed his researches on the assumption that there are common laws of interaction in Nature at any level of presentation of matter. What is true for the microcosm should be fair for a human being (in terms of interaction). And vice versa: the informational (non-forceful) interaction of human beings must have analogue in the micro-level of Nature. And if the human behaviour is determined by its internal (informational) contents, then, by analogy, the behaviour of any material objects should be determined by their internal (information or similar to informational) contents.

The work, which is offered for your consideration, is based on the notion of the manifestation in movement and interaction of material objects, their certain internal functionality, internal structure, internal organisation – that we can compare to the information. Such a view corresponds to the concepts of manifestation of information content of people in their behaviour. In the work the information functionality is transferred to the inanimate objects. The introduction of such information function to the formulae which represent the physical laws allowed to build the mathematical model that describes the processes of non-forceful interaction in the subject domains of human activity (by analogy with the physical laws implemented in Nature). These studies were laid into the basis of the non-forceful interaction theory.

Thus, the combination of physical laws with the supposed initial informational cause of manifestation of material objects allowed formalizing and integrating the physical and informational aspects of existence through the prism of the universality of the laws of non-forceful interaction in Nature.

This monograph is devoted to the description of the author's view on the processes of transformation of the informational content of Nature, the mechanisms of functioning of its information processor, experimental confirmation of the obtained results and their practical use.

PART 1
NATURE OF REFLEXES

1.1. Reflex and probabilistic approach to description of the intellectual activity of a human

The scientific work, the results of which are proposed for your consideration in this monograph, was originally done in the sphere of artificial intelligence. The first author's investigations on this topic were published in 1982 [1-2]. Weak at the time, knowledge in the field of artificial intelligence, particularly the knowledge of approaches, methods and models of building the systems of natural language communication, pattern recognition, expert systems, robotics, have led to the fact that the author began to search for "his" ways of solving problems in the sphere of Artificial Intelligence. The starting point in these studies was the understanding of the fact that the activity of natural intelligent systems is based on conditional reflexes, which are produced as a reasonable reaction to everything that happens in the environment. The author basically made an attempt to formalize the rules of behaviour of artificial intelligence systems proceeding from the examples of reflex conditioning in living organisms. This direction of research was chosen intuitively, generally under the influence of Nikolai Amosov's works [3-4]. After some time the author got to know that there is the conception in the artificial intelligence according to which the intellectual activity of the human is also a reflex by its nature as even the interactions on the level of the second signalling system (words) are ensured by the compound reflexes.

But in contrast to the traditional approaches the author, while searching the generation of reflexes, paid his attention to the fundamental physical laws. Why? Because both living and inanimate matters "response" to the influence: inanimate matter – in accordance with the physical laws, living (organized) – in concordance with the algorithms of behaviour of self-managed systems. The author assumed that there were the processes of the same type in the basis of the response to the influence in both micro- and macrocosm: receipt, processing and use of information about influence for the generation of response corresponding to some laws unknown to us. Then, what is true for the microcosm should also be true for the human (in part of interaction) and vice versa: informational (non-forceful) interaction of the human should have the analogue on the macro level of Nature. And if the reflexes of human are defined by his/her internal (informational) content then may be the behaviour of any material objects is "a reflex" and is defined by their internal (information or similar to information) content.

What is the easiest way to illustrate a reflex? – By the rule "if-then". If the influence on the biological object is X, then the response of biological object is V. If the influence on the biological object is Y, then the response of the biological object is U. Then the question can be asked. And what if the biological objects are influenced by X and Y? The answer can be the following. If the biological object is under the simultaneous influence X and Y, then the preferable response of the biological object is U, less preferable – V. Mathematically this is written through the conditional probabilities

$P(V/X)\approx 1$ – probability of response V under the influence of X.
$P(U/Y)\approx 1$ – probability of response U under the influence Y.
$P(V/XY)$ – probability of response V under the influences of X and Y.
$P(U/XY)$ – probability of response U under the influences of X and Y.
$P(U/XY) > P(V/XY)$.

But what is the correct way to choose the response to the different influences? How can the correct transition from partial conditional probabilities $P(V/X)$, $P(U/X)$, $P(V/Y)$ and $P(U/Y)$ to the joint $P(U/XY)$ and $P(V/XY)$ be found? How can one find the conformity in such a transformation?

The task includes the development of such a method which will allow obtaining the value of joint conditional probability through the partial ones, which is as close to the actual value as possible. After all, if over the life a person experiences *N* situations in which partial conditional probabilities are equal, for example *P(V/X)=0,2* and *P(V/Y)=0,3*, and unconditional/absolute probability is *P(V)=0,1*, then the assessment of joint conditional probability must be equal to the mathematical expectation of joint conditional probability:

$$p_{\text{exp ectation}}(V / XY) = \lim_{N \to \infty} \left(\frac{\sum_{i=1}^{N} p(A_i / B_i C_i)}{N} \right),$$

under the condition of:

$$\forall 1 \le i \le N : p(A_i) = 0{,}1; p(A_i / B_i) = 0{,}2; p(A_i / C_i) = 0{,}3.$$

1.2. Ignorance which pushed to knowledge

From the standpoint of today's science (and probably that is the point of view of the majority of scientists), there are no general regularities in the interrelation of partial conditional probabilities with the joint one. In extreme case, such regularities are specific to each subject domain. But when starting the research, the author did not know that. To solve the set problem the following hypothesis was put forward: if there is such regularity, then it should appear within the existent systems: biological or physical.

Reflex human behaviour is possible only in case when such dependence exists in the human environment, because reflex is a response to the irritation of reflectors, which happens simultaneously with a great number of irritations that do not initiate this reaction. And human brain is able to "single it out" and "select".

But if the human brain "distinguishes" such dependence and implements a method for evaluation of joint conditional probabilities through the partial ones, then it means that such regularities exist in Nature, and the neurons of brain reflect them.

It was the search of correspondence in «reflex» behaviour of material objects which are different by their nature that became the subject of scientific studies conducted by the author and set forth in this monograph.

We will illustrate the stated problem with the examples, the solution of which will be presented in the Part 6 (after the elaboration of the method for evaluation of joint conditional probabilities through partial ones).

1.3. Problem statement of the research in examples

Example 1.1. Let us assume that the unconditional probability of reaction in some situation is equal to 0,02. For example, this is the unconditional probability of that the student will get an "excellent" mark for his test on the discipline "Artificial intelligence systems" without training and use of lecture notes.

$$p(A) = 0{,}02,$$

where *p(A)* – the unconditional probability of getting an "excellent" mark on the results of testing on the discipline of "Artificial intelligence systems" without training and the use of lecture notes.

As the experience has shown, the probability to get an "excellent" mark for the students who were trained before testing in the training mode during 1 day is equal to 0.08. This is the conditional probability (on condition of the training).

$$p(A / B) = 0{,}08,$$

where $p(A / B)$ – the probability of getting an "excellent" mark on the discipline of "Artificial Intelligence Systems" on condition that the student has trained for 1 day.

If the student will not train before testing, but will use his lecture notes during it, then he will be able to get an "excellent" mark with the probability of 0,15.

$$p(A / C) = 0,15,$$

where $p(A / C)$ – the probability of getting an "excellent" mark on the discipline of "Artificial Intelligence systems" on condition that the student will use his lecture notes during the test.

What is the probability to pass the exam with an "excellent" mark if the student trains before testing and uses his lecture notes?

Example 1.2. Let us assume that in the current situation there are three conditions and two possible reactions:

1. $p(R_1 / x_1) = 0,1$, $p(R_1 / x_2) = 0,85$, $p(R_1 / x_3) = 0,6$;

2. $p(R_2 / x_1) = 0,9$, $p(R_2 / x_2) = 0,15$, $p(R_2 / x_3) = 0,4$.

Unconditional probabilities of reactions: $p(R_1) = 0,3$; $p(R_2) = 0,7$.

It is necessary to evaluate $p(R_1 / x_1 x_2 x_3)$ and $p(R_2 / x_1 x_2 x_3)$.

Example 1.3. The student attends on average 275 out of 500 classes per year. He attended 15 classes of 50 in the days when it was raining. And he visited 20 out of the 25 classes of professor Myslenko. The question is what is the expected probability of student's attendance of the lecture of Professor Myslenko if it is raining?

Example 1.4. The probability of catching the flue during the autumn-winter period for an adult is 0.20. Among those who have regular physical exercises 5% of the adult population gets sick. And it is 35% among teachers in secondary schools. What is the expected % of illness rate among the teachers of physical training?

Example 1.5. In the Ukrainian Football Premier League the owner of the field is earning an average of 65% points, but if the team loses, then it earns up on average only 45% points in next match. If the same occurs with the team, which is above the former in the standings, it earns, on average, only 40% points. And finally, if a break before the match is 7 days, then such a team, on average, earns 53% points. If the team plays at home after losing the previous match, which was 7 days

before the current one, and its opponent is higher in the standings, what is more expected – the victory or defeat of such a team?

Example 1.6. The Carpenter Teslya works 200 days per year out of 250. He worked only 9 days out of 45 working Mondays, but he worked on the payday or advance in 9 out of 10 cases. Is he expected to work if the payday is Monday?

Example 1.7. If the word "estimate" occurs in the natural-language request to the intelligent system, then with the probability 0.75 its result should be the cost of works, with the probability 0.10 – the presence of estimates, and with the probability 0.15 it will be a different result. If there is the word combination "reactor building", then the probability of that the result should be the cost of works 0.50, the presence of documentation- 0.2 and a different result – 0.3. During the work of intelligent system the statistics on the results which the users need was accumulated. In 35% of the cases – the cost, in 30% – physical volumes, in 20% – the presence of documentation, and in 15% – resources needed to implement the plan. Evaluate what module is required for the implementation of the request (forming of estimated cost, defining whether there is the estimates or other), which has the words combination "reactor building" and "estimate".

PART 2
INTERNAL CERTAINTY OF THE MOTION IN NATURE

2.1. Information as the Essence of Organisation

Human behaviour depends on his/her attitude to what surrounds him/her, on his/her attitude towards existence. Speaking, writing, facial expression, movement – all this shows his/her inner world. As we are used to say, his information. But is it right? There is a very good definition of information in the Encyclopaedia of Cybernetics. **Information** is the property of objects and processes to form a variety of states, which are transmitted by displaying from one object to another and remain in its structure (perhaps in a modified form) [10]. But accepting this definition we should answer several questions:

1. What is there in objects and processes that forms the property which we call information?

2. Which connection is there between the ability of some entity to form a variety of states with the messages, data, and knowledge which are received by this entity and which contain information?

3. The notion of information is tightly connected to the classical quantitative measure [11]. This quantitative measure has nothing in common with the process of formation of "diversity of states". Then, the question arises – how to connect the number of bits received by the receiver (the subject) with its ability to form a variety of states.

That is why, the notion of information, as close as it may be, does not entirely correspond to the understanding of the category which forms the human behaviour. Why? Let us look at the role of information in people's lives. There is a common recognition that the information reduces uncertainty. We did not know how the World football Cup 2006 would pass. Therefore, it was considerable uncertainty of that who would become the champion and who – the prize winner, what place the Ukrainian team would take. Information about how the world football championship was held, about its results eliminates this uncertainty. Does this information change the reality? Being? When the person, who has received this information, is in future involved in conversations devoted to the World Cup 2006, then his/her statements are, without doubt, completely different from those that would have been before he/she got to know the results. Actions (manifestations) of this football fan will change. The trajectory of his/her movement through life will change. It is because the different statements and actions (manifestations of the received information) will lead to different information interactions, and, hence, to different response reactions of others. This, in its turn, will lead to other information which is obtained from the human environment.

In essence, "who we are" is determined by the sum of such information impacts on us and depends on the trajectory of our movement through life. Under the trajectory of movement through life of a subject we mean the sequence of physical and informational contacts (interactions) with the objects and subjects of the environment, leading to the changes in information about this environment, which the subject has. And this leads to the change of action of the subject – the choice of new contacts and, consequently, to a new trajectory through life. In this case, each non-forceful (informational) interaction is characterized by the subject of interaction (who interacts), the object of interaction (with respect to which there is an exchange of information) and the attitude to the object of interaction (information about the object of interaction). Changing of one parameter leads to receiving of other information by the counter-agents of interaction and results in other actions of the subjects of interaction.

This peculiarity of information interaction is well-known to the philosophers and psychologists. And its use in this monograph is caused not by the need to disclose the regularities of informational interaction of people but to show the other side of information, the side which the researchers pay almost no attention to.

Let us step aside from a narrow understanding of information as something which is contained in the messages, data and knowledge, which reduces the entropy of the recipient of information, and try to look at the essence of information in a different way. Receiving of information does not simply reduce the uncertainty of the one who received it. Information changes the attitude to being of the person who received it. His/her attitude to the environment is now different. In fact, new information forms his/her new attitude to reality (agree / disagree, like / dislike, evokes positive / negative emotions). This attitude, in its turn, is a source of actions, which are different from those that would have been, if the information hadn't been received (Fig. 2.1).

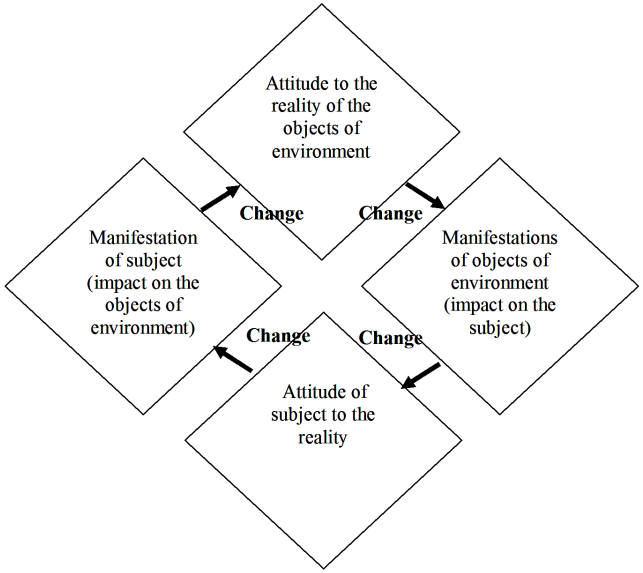


Fig.2.1. Scheme of changing of attitude to the reality in the processes of interaction with environment

Thus, the information changes the attitude to the environment (to the reality) of those people, who have received it. And, thus, it generates their different behaviour. I have no information and I cannot determine my attitude to something about which I lack information.

And if my attitude to something is formed, then I got a certain amount of information that allowed me to form (or that formed) my attitude to something in this world.

In this sense information is the derivative from the organisation. More precisely, the organisation of material objects of Nature is the source of information. The internal organisation of a person forms his/her actions, his/her manifestations in the environment. These manifestations have the form of movement, gestures, speech and writing, etc. The human being is organized in this very way. Human behaviour is stochastic for an outside observer. In the morning, the person may: go to work, stay with his/her family, go to visit his/her friends. If you observe such a person for a long time, you can approximately determine the probability of these actions. But without knowing the inner world of a person, without possessing his/her "internal structure" we cannot predict his/her behaviour accurately. Indeed, the probability of human behaviour is determined by his/her internal organisation. And we can talk about the existence of connection

$$\textbf{internal organisation} \rightarrow \textbf{probability}. \qquad (2.1)$$

2.2. The Internal Organisation

And what if the role of "internal organisation" in the inanimate Nature is the same as in the living one? What if the "internal organisation" forms not only the human behaviour? Not only of biological objects? The internal organisation of any material objects manifests their "attitude" to the reality (to being). This internal organisation is the essence of the material object itself. It can neither be separated from it nor transferred. And just as "internal organisation" of a person sets his/her "stochastic" behaviour, the internal organisation of any material object sets its manifestations (manifestation to the world). And through the reflection in the processes of interaction, this "internal organisation" becomes "known" (the information appears) to other material objects.

The number of scientists went to even greater extremes. There is an open letter of the outstanding scientists of the world, who consider the formation of existent diversity of Nature to be "non-random". Perhaps the selection and development in Nature are described by stochastic processes with a limited search. Perhaps there is some rationality and purposefulness in the stochastic processes that led at first to the formation of amino acids, then to the simplest biological objects of flora and fauna, and finally, to the human being.

Summarizing the above stated, Let us extend the given understanding of "internal organisation" to cover all material objects of Nature. So, the existence of the internal organisation of objects and processes of the universe are accepted. The internal organisation forms the behaviour (manifestations) of any material objects (by analogy with human), and not just of a human, and thus becomes the source of information.

If we search for the analogy in «the property of objects and processes to form the manifestations on different levels of motion of the matter», then we need to find the corresponding transition from the internal organisation to the manifestations of objects of the inanimate nature. To do this, it is necessary, in the first place, to "see" the role of internal organisation in the physical processes, to learn its essence not only on the macro level and on the level of existence of self-managed systems, but on the macro level in the inanimate nature as well. If the internal organisation forms the "attitude" of all material objects, then how is it formed, changed, measured, and transmitted? The result will depend exactly on the answer to these questions – understanding of informational essence of Nature – its informatics.

If the person manifests his/her internal organisation through motion, body language, oral and written speech, then how do the inanimate objects manifest their internal organisation? On the basis of the fact that the interaction in Nature leads to the change of direction and speed of motion we can say that the internal structure of material object is manifested by **MOTION [12]. Then, by analogy with the human, the motion is not the result of external enforcement to move. It is the result of manifestation of "internal will" (internal organisation) of the object itself.** And again, by analogy with the human, the direction can reflect some truth in motion (where to go), and the speed probably reflects the attitude of the material formation to this truth. In such a model

the quantitative measure of internal organisation should reflect the value of truth (certainty, confidence, credibility) of the direction of motion.

But how can one connect the internal organisation that determines the manifestation of material object with its manifestation (motion)? How to present and how to measure the internal organization, which "sets", for example, movement at the speed of 100m/s? Let us consider one of the variants of connection of the material object internal organisation with the motion.

2.3. The Informatics of Motion

We will proceed from the point that the explanation of internal nature of motion should be as simple as possible. There is the well-known fact which is verified by practice of many generations of scholars – the formulated laws of Nature should be harmonious and simple to be true. Mathematical representation of the internal character of motion should necessarily contain as little attributes as possible, be simple and understandable and explain theoretically formed and experimentally verified laws of motion.

To the traditional understanding of physical movement it is inherent:

- expression of different directions;
- expression of different speeds.

Herewith, the speed of motion is taken equal to the speed of displacement of material object. Moving of object X with the constant speed Y in the direction Z was always understood:

a) as movement in the direction Z;

b) as displacement to Y units of distance per one unit of time.

The laws of motion should ensure the establishment of:

a) the directions of motion;

b) different speeds of motion.

A simpler variant of implementation of the laws of motion can be based on a slightly modified scheme that uses the mentioned connection between the internal organisation and the probability (expression 2.1).

But there is no probability in the traditional model of motion. We will introduce it there proceeding from the following assumption. It is known that the change of direction and speed of motion is the result of interaction of material objects, and the laws of Nature provide the formation of different directions and different speeds of motion. And what if we simplify the model and imagine that there is only one speed of motion in Nature, the speed of displacement (jump) on a quantum of space in a quantum of time. Herewith, the probability of displacement in one or another direction is the internal attribute of moving object and is determined by its internal organisation (Fig.2.2).

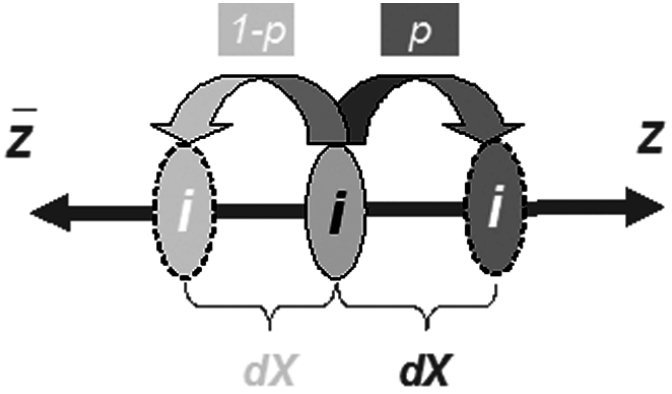


Fig. 2.2. Scheme of a displacement of material object

We will consider the motion as a displacement in different directions which are designated with different probabilities of [12, 32]. Consider the case of one-dimensional motion of one object (Figure 2.3).

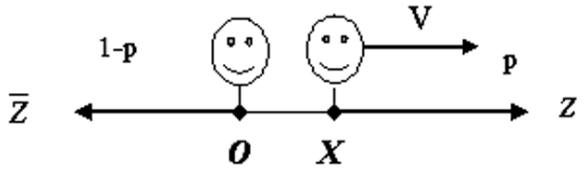


Fig.2.3.Probabilistic interpretation of motion of one object

Let the possible directions of motion of object *X* with respect to the object *O* be the directions *Z* and *Z* (the direction opposite to Z). Moving of object *X* is understood as a drift in the direction, the probability of which is bigger.

The expected drift velocity in the direction *Z*:

$$V = (p-(1-p))\cdot\nu\cdot dX = (p-(1-p))\cdot\frac{dX}{dT},$$

where *V* is the expected drift velocity in the direction *Z*; $\nu = \frac{1}{dT}$ is the quantity of displacements per a time unit; *dT* is a value of quantum of time; *dX* is a value of changing of distance in one quantum of time (the value of quantum of time); *p* is the probability of realization of displacement in the direction *Z*; 1 – *p* is the probability of realization of displacement in the direction opposite to *Z*.

Maximum drift velocity corresponds to $p=1$ ($p=0$):

$$p=1 \Rightarrow V_{p=1} = (1-(1-1)\cdot\frac{dX}{dT} = \frac{dX}{dT} \quad \frac{unit\ \text{of}\ distance}{unit\ \text{of}\ time},$$

where $V_{p=1}$ is the drift velocity in the direction *Z* at $p=1$.

$$p=0 \Rightarrow V_{p=0} = (0-(1-0)\cdot\frac{dX}{dT} = -\frac{dX}{dT} \quad \frac{unit\ \text{of}\ distance}{unit\ \text{of}\ time},$$

where $V_{p=0}$ is the drift velocity in the direction *Z* at $p=0$.

Thus

$$V_{\max} = \left|V_{p=1}\right| = \left|V_{p=0}\right| = \frac{dX}{dT} \quad \frac{unit\ \text{of}\ distance}{unit\ \text{of}\ time},$$

where $V_{\max}$ is the maximum possible drift (motion) velocity in Nature.

From the special theory of relativity it follows that the maximum speed in Nature is the speed of propagation of light in vacuum – c. If we assume that the propagation of light corresponds to the unidirectional displacement (displacement in one of the directions with probability 1), then we can write

$$V_{\max} = \frac{dX}{dT} = c,$$

where *c* is the speed of light in vacuum.

From this, it follows that

$$V = (p - (1 - p)) \cdot c = (2 \cdot p - 1) \cdot c . \qquad (2.2)$$

Or inverse dependence

$$V = (2 \cdot p - 1) \cdot c \Rightarrow p = \frac{V + c}{2c} . \qquad (2.3)$$

Let us consider the case of motion of two objects. Let the two material objects *X* and *Y* (Fig.2.4.) move in the direction *OZ*.

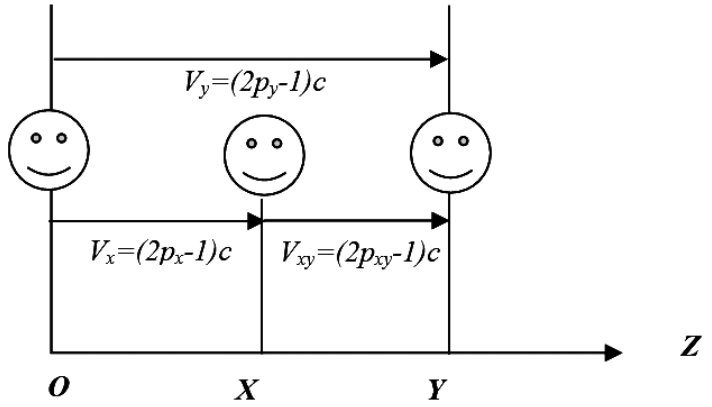


Fig.2.4. Probabilistic interpretation of motion of two objects

At the given drift velocity of the objects *X* (V_x relative to the point *O*) and *Y* (V_y relative to the point *O)* in the direction *Z,* the drift velocity of the object Y relative to the object *X* (V_{xy}) from the formula of the relativistic addition of velocities will be equal to:

$$V_{xy} = \frac{V_y - V_x}{1 - \frac{V_x \cdot V_y}{c^2}} = \frac{(2 \cdot p_y - 1) \cdot c - (2 \cdot p_x - 1) \cdot c}{1 - \frac{(2 \cdot p_x - 1) \cdot c \cdot (2 \cdot p_y - 1) \cdot c}{c^2}} .$$

Hence,

$$V_{xy} = \frac{p_y \cdot (1 - p_x) - p_x \cdot (1 - p_y)}{p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y)} \cdot c \text{ (at } \left| p_x + p_y - 1 \right| \neq 1). \qquad (2.4)$$

The numerator of expression (2.4) defines the difference in the displacements in the opposite directions. But the denominator captures only those displacements, in which the objects are on the opposite course. Displacements in one direction in the expression (2.4) are not taken into account. Their number is equal to 0?! Indeed, we would obtain for statistically independent displacements the value

$$V_{xy} = (p_y \cdot (1 - p_x) - p_x \cdot (1 - p_y)) \cdot 2c =$$
$$= \frac{p_y \cdot (1 - p_x) - p_x \cdot (1 - p_y)}{p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y) + p_x \cdot p_y + (1 - p_x) \cdot (1 - p_y)} \cdot 2c.$$

That is different from the expression (2.4) on the additional sum in the denominator $p_x \cdot p_y + (1 - p_x) \cdot (1 - p_y)$ – probability of displacements *X* and *Y* in one direction, and on the coefficient 2 κ to the speed of light. From this, it follows that

$$p(X,Y) + \overline{p(X,Y)} = 0 ,$$

where $p(X,Y)$ is the probability of simultaneous displacement *X* and *Y* in the direction *Z*; $p(X,Y)$ – the probability of simultaneous displacement *X* and *Y* in the direction, opposite to *Z*.

There are no displacements in one direction?! It turns out that the objects *X* and *Y* exist relative to each other only if they are in "the opposite directions" – move in the different directions. Maybe **the objects which move in one direction "do not see" each other, do not exist as separate entities and represent the single object?**

In such a model the motion is the property of the object itself and not the result of comparing of the movements of the observer and the object. Between the observer and the observed object, there is, in general, the difference in internal organisation, manifested in the relativity of motion (this difference in physics is treated as «relativity»).

What is the probability of displacement of object *Y* relative to the object *X* in the direction *Z*? Taking into account (2.4) we can say that the

objects under consideration *(X* and *Y)* always displace relatively each other in different directions. That means that the object *Y* displaces relatively the object *X* either in the direction *Z* or in the direction opposite to *Z*. In this case the velocity of relative displacement will correspond to the expression (2.2)

$$V_{xy} = (2 \cdot p_{xy} - 1) \cdot c.$$

Now we will move in the expression (2.4) from the velocity to the probability of displacement of the object *Y* relatively the object *X* in the direction *Z*

$$(2 \cdot p_{xy} - 1) \cdot c = \frac{p_y \cdot (1 - p_x) - p_x \cdot (1 - p_y)}{p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y)} \cdot c.$$

Assuming that $|p_x + p_y - 1| \neq 1$ we find p_{xy}: $(\text{at} |p_x + p_y - 1| \neq 1).$

$$p_{xy} = \frac{1}{2} \cdot \left(\frac{p_y \cdot (1 - p_x) - p_x \cdot (1 - p_y)}{p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y)} + 1 \right) = \frac{p_y \cdot (1 - p_x) - p_x \cdot (1 - p_y) + p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y)}{2 \cdot \left(p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y) \right)} =$$

$$= \frac{2 \cdot p_y \cdot (1 - p_x)}{2 \cdot \left(p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y) \right)} = \frac{p_y \cdot (1 - p_x)}{p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y)}.$$

Thus

$$p_{xy} = \frac{p_y \cdot (1 - p_x)}{p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y)} \quad (\text{at} |p_x + p_y - 1| \neq 1). \tag{2.5}$$

Hence we find. At p_y. At $|p_x - p_{xy}| \neq 1$:

$$p_y = \frac{p_x \cdot p_{xy}}{p_x \cdot p_{xy} + (1 - p_x) \cdot (1 - p_{xy})}. \tag{2.6}$$

From the above stated, it is evident that the motion is convenient to consider as the displacement with the same speed in different directions that are stipulated with different probabilities. The presented probabilistic interpretation of motion suggests that **there is the single speed of displacement (motion) in Nature – the absolute speed – the speed of propaga-**

tion of light in vacuum – *c*. This finding could clarify the postulate of special relativity which determines the constant speed of light relatively any motion. So, it turns out that the speed of motion of anything in Nature is constant and equal. And it is equal to the speed of light. Everything moves (displaces) with the speed of light. But due to the fact that the motion takes place in different directions which are stipulated with different probabilities, the speed of motion of material objects is less than the speed of light.

In order to make the assumption about the "internal" nature of motion even more convincing, it is necessary to find the reasonable, simple and beautiful explanation of the received dependencies. And this we will do.

2.4. What do the obtained dependencies show?

As it follows from the previous subsection, the mechanism of interaction in Nature is perhaps built on the principles of discretization of manifestations of internal organisation in the states of material objects with adjustment of this formation according to the results of match or mismatch of manifestations. Imagine the Universe as the complex of material objects in motion. Herewith, the motion manifests internal organisation of material objects and is implemented through the displacement. Displacement is one discrete change of the distance between the different material objects which is formed in discrete moments of time. At this, the motion is the property of the object itself, but not the result of comparing the motion of the observer and the object.

At each discrete moment of time every material object forms its direction of displacement, which matches or is opposite to the directions of displacements of other material objects. Each displacement is the manifestation of the attitude of one material object towards other material objects; it is the match or mismatch of this material object with others.

If the distance between the material objects has changed, so these are different objects, with different internal organisation, because they have different displacements and they are different objects in that discrete moment of time. If the displacements have been in one

direction and the distance between them has not changed then they are the same object in this very moment of time (2.4).

It is quite reasonable to suppose that the frequency of "match" and "mismatch" with the direction of displacement of other material object reflects the probability of selection of displacement's direction, but the probability of selection of displacement's direction is formed by internal organisation of material object. In fact, the internal organisation of material objects is manifested in the direction of displacement, in the sense of "truth" of just this very direction (and "falsity" of the opposite one). To what extend more often the material formation displaces in one direction then in the opposite is set by the probability of displacement in these directions. And the probability of displacement in these directions is determined by the internal "preference" of one direction over the other one. Thus there must exist the dependence

internal organisation →probability → frequency of displacement in a direction. (2.7)

Displacement of a material object **manifests** (**shows** to our world) its internal organisation. If we assume that the cause of interaction in Nature is "mismatch of opinions about the true direction of displacement", then it is the displacement that "materializes" the internal organisation, manifests it as interacting material objects. To be more precise, the displacements themselves being the product of internal organisation of material entities are something that we see as the material world which surrounds us.

What does the displacement in/opposite to the direction of other object's displacement demonstrates? As it follows from the expression (2.5) it demonstrates whether these material objects are the same or different. So, their internal organisation manifests the attitude towards the other material objects – if they match or mismatch with them. We can say that:

Definition 2.1. Internal organisation of material objects reflects the attitude towards being (towards the truths formed by the reality).

The role of internal organisation of any material objects is the same as in the life of a human – formation of his/her behaviour through the attitude to being. It is impossible neither separate the internal organisation from the material object nor transfer it to other material object. Internal organisation is "transferred" and changed through

the matches or mismatches of manifestations of material objects. If the object manifests itself in such a way, then it has such internal organisation, such attitude towards the other material objects. The internal organisation can never and in no way be singled out, be observed apart from those objects the manifestations of which it forms.

In this variant of the Universe in every moment of the time two subsets of material objects, which are in different manifested relations (in manifestation of the agreement in each of subsets and the disagreement between the material objects of different subsets), are formed. Upon every new "appearance" the content of subsets, in the common case, will be different. Along with it (See Fig.2.4):

• material objects move relatively each other if they are in different manifestations;

• material objects do not move relatively each other (probably do not interact and exist as different objects) if they are in the same manifestations.

Material objects in the same manifestation represent in essence one material object. As marking out of a material object among the material objects in the same manifestation is equal to the search of white spot on white background. Is it possible? No, undoubtedly. The spot is characterized (for the observer) by the colour which is different from the surrounding background. The same is for the material objects; the material objects with manifestation which is different from "background" can serve as a spot. As it follows from the formula (2.5) the material objects with the same manifestation (displacement in one direction) are in no way manifested relatively each other, thus, they are not different material objects at this moment. They either do not exist (which contradicts to the possibility of their manifestation relatively other material objects) or they represent one material object. On the other hand, as it is seen from (2.5), the objects in different manifestations move one relatively the other, and consequently, they exist relatively each other.

Thus, based on the assumption about the existence of the single speed of motion (displacement), the probabilistic model of motion in Nature was proposed. The main thing that is presented in the Part is the demonstration within the probabilistic interpretation of motion of that the different material objects exist only when they displace in different directions.

Under such an interpretation of motion there are two questions which are not covered. Firstly, what is Nature of internal organisation? It is necessary to determine its essence, role, disclose the processes of its formation and change on the basis of the dependencies obtained above. It is necessary to find the appropriate term for the definition of internal organisation, "measure" its quantity as a source of manifestation (apparition to the World) of material objects. And harmonize this quantity with the probability of manifestations (displacements) of material objects. Secondly, it is necessary to interpret the interactions in Nature from these positions. Next two chapters of the monograph will be devoted to these questions.

PART 3
NATURE OF INTROFORMATION

The chapter is devoted to the comprehension of the results of probabilistic interpretation of motion, stated in the previous part. The author tried to combine the understanding of the role of internal organisation of material objects as a source of motion with the understanding of information which lies in the basis of intelligent life in the Universe. The idea is very simple. If the laws of change of internal organisation are universal for any material objects then when revealing them on the micro level we can generalize the obtained formal notion on the macro level of Nature. And understanding the role of internal organisation (more precisely, role of information) on the level of existence of complex matter, we can transfer this understanding on the micro level as well, on the level of existence of inanimate matter.

3.1.Introformation

(The term was proposed by O.V. Teslia)

Information in the conventional meaning is what we daily receive through our sense organs while interacting with the environment. Information leads to the change of our attitude to the reality. So, something changes inside us. Our internal organisation expressed by the relations between the neurons and their groups changes. Because of this change, our attitude to the reality changes, which leads to our manifestations, different from the past ones, in the environment, and this gives new information to the people perceiving these new manifestations.

As it is shown in Part 2, the manifestations of material objects (displacements) are probabilistic and reflect their attitude to some truth (direction of motion) and to the manifestations of other objects.

The closest notion to the presented understanding of internal organisation of material objects is the notion of information. There are two concepts, two views on Nature of information. Within the first concept (technical) under the information one understands messages, knowledge, data, intellectual resource etc. Within the second (philosophical) one understands information as some general category of Nature, property of matter, source of vital activity of biological objects. As it has been already said, in the encyclopaedia of cybernetics [10] information is defined as the property of objects and processes to form the diversity of states, which are transferred by means of reflection from one object to another and are kept in its structure (probably in the changed form). The notion of information is linked with the classical quantitative measure [11]. And this quantitative measure has nothing in common with the process of formation of "the diversity of states". That is why, though the notion of information is the closest it still does not precisely meet the notion of category, which forms the behaviour of material object and fits the notion of internal structure (internal organisation) in functional understanding. And as it follows from the definition 2.1, it reflects the attitude of material object to the truth expressed by the reality.

In the non–forceful interaction theory the category of attitude to reality was named information. Thereby there was not even duality, but triplicity of the notions, concealed in one and the same term – "information". That is why, the author proposes to call the internal organisation of material objects which forms their manifestation as introformation (*intro<Latin>*– directed inside, internal; *formation <Latin.>*– formation, forming, structure, organization).

3.2. So what is introformation?

Definition 3.1. Introformation is internal organisation of material objects which reflects their attitude towards the truth (reality) and is the source of their manifestation (apparition to the World).

The author regards as the material objects which manifest "the internal organisation" not only people, fauna and technical systems, but also the surrounding objects which we observe, elementary particles, quarks, waves etc. – everything that has been discovered experimentally or mathematically, got the name and is the attribute of physical processes in the Universe.

It can be said in more simple way.

Definition 3.1'. Introformation is the category of attitude towards the truth (towards reality).

Definition 3.2. Attitude towards the truth (reality) is a positive or negative perception of environment evoked by the condition of reality (manifestation of other material objects).

Introformation is the source and moving force of manifestation of material objects in Nature. But it is not the element of material World. The internal organization cannot be understood as "material" structure of material object. It is rather the internal first cause of being which lies behind (or inside) the material World.

The model of formation and manifestation of attitude towards reality of Nature's material objects (the model of work of "information processor of Nature") which will be based on the introduced notion of introformation will be called **introformational.** It is the introformational model that will lie in the basis of solution to the task set in the first part. To build such a model one should reveal the laws of operation of introformation in Nature, and transfer the knowledge about such laws to the artificial systems and processes. If Nature operates the introformation, then Let us transfer its laws to the fields of human intellectual activity as well. If we disclose how the information "generates" the dependencies between the partial and joint conditional probability in natural systems, then we will be able to use these dependencies for the creation of artificial intelligent systems and even for the creation of "the artificial Nature".

3.3. The Jug for Introformation

Accepting the fundamental character of essence hidden behind the term "introformation", the author assumes that introformation is the essence of formation of states of all material objects, and not only of the human.

As it was defined in Part 2, the internal organisation is the source of information and forms the behaviour (manifestations) of any material objects (by analogy with the human) and not only of the human (Fig.3.1).

It is the property to determine the diversity of states of material objects that is formed by introformation. Introformation is something which defines the states (manifestation) of material objects. Under the property of determination one understands "capability" of introformation to set (form) the states of material objects. It is more correctly to say – **to manifest** material objects in different states. Under the introformation one understands the "category of the attitude towards reality"; in common case, it does not set the definite final result, but makes some of the variants of material objects' manifestation more or less preferable. At this, the mechanism of "transformation" of introformation (attitude towards reality) into the manifestation of material object is not covered by this work. To begin with, it is necessary to define the role and place of introformation in the formation of diversity of everything that exists in Nature.

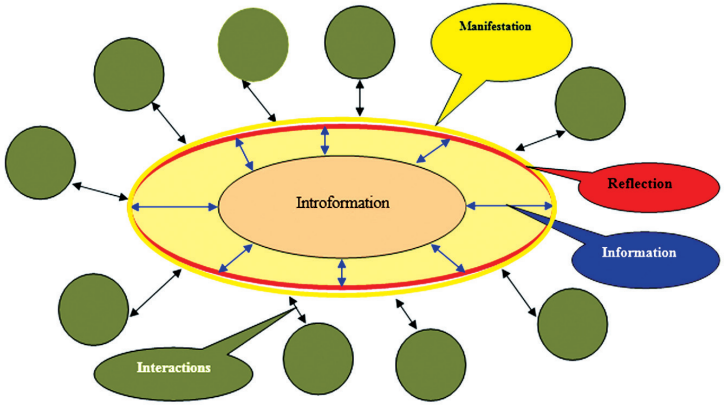


Fig.3.1. Place of introformation in the processes of interaction

There is something in Nature that we can observe. What surrounds us? – *Something* that is manifested in the form of different material objects. The notion of the term "to manifest" has two sides – to manifest means that there is *something 1* and there is *something 2* between the different *something's 1* which allows "to sense" other *something's 1*. There is the category of "existence" of something and there is something that sets the attitude towards the things that exist.

Something 1 is the objective reality that is manifested in the form of material objects. *Something 2* is provided by such a formation of the laws of Nature where material objects constantly "correlate" with each other – interact with each other.

Thus, we can distinguish two categories that fit into the introformation model of Nature:

There is something in it that we call **the material objects** of Nature.

Every material object has the ability to "take into account" the existence of other material objects and to act in accordance with the "behaviour" of other material objects.

In other words, there is something that exists in the Universe. And all that exists is related to everything that exists. Consequently, **each material object is characterized with existence. And it is characterized by the attitude to existence. These two characteristics generate the infinite diversity of Nature.**

From the probabilistic representation of motion (Part 2) we can conclude that the attitude of material object is the attitude to the truth which is set by:

1. Direction of motion.
2. Displacement of material objects.

The attitude towards "the direction of motion" can be within the limits expressed by qualitative measures: "I fully agree with the direction of motion", "I do not agree with the direction of motion". There are a number of values on this scale, such as: "I slightly disagree with the direction of motion", "I almost agree with the direction of motion" etc.

The attitude towards the "other" material object can be within the limits expressed by qualitative measures "I am other material object", "I am not other material object". There are a number of values on this scale, such as: "I'm slightly similar to other material object", "I'm al-

most the same as other material object" etc. Further, to represent the qualitative scales it will be offered a quantitative measure of the attitude towards the truth (reality).

Perhaps, the distance between the material objects in Nature corresponds to the attitude between them.

Objects of Nature contain the attitude towards reality and are able to show this attitude. Attitude towards reality is something that identifies the material objects, and it is generated by their **introformational content**. Different objects of Nature are different attitudes towards reality, different entities, and reality is the apparition of other objects of Nature. **The apparition** of the object of Nature is the manifestation of the attitude towards reality. Material objects manifest themselves through their motion (displacement). Different objects of Nature are different manifestations, different displacements.

As it was shown in Part 2, the manifestation of material objects is their displacements (jumps, transitions) in the direction of or against the motion.

Definition 3.3. Manifestation of the material object is a displacement in space (change of coordinates), a single motion, and an action.

Manifestation of material objects relatively each other can be expressed by the words: "Coincide" (agree with other material object with respect to the direction of motion), "do not coincide" (do not agree with other material object with respect to the direction of motion). At this, the probability of displacement should be considered as a secondary (derivative) relatively the introformational content. Manifestations of material objects "materialize" their introformational content, manifest it relatively other material objects, launch the mechanism of interaction (perhaps, with the goal of "elaboration" of the common attitude towards reality).

The above stated can be confirmed by the following example. *The Verkhovna Rada is voting on a certain law. The Chairman announces – "Vote for the adoption of the law on first reading". "I am against". Everybody votes. After the voting the Chairman announces again: "Vote for the adoption of the law on first reading". "I am for". And so on. The frequency of the statements "For" and "Against" of the Chairman matches his attitude towards the question (the extent to which he is convinced of the correctness of a decision). How do the deputies vote? One part of the deputies has its own opinion that ignores or slightly takes*

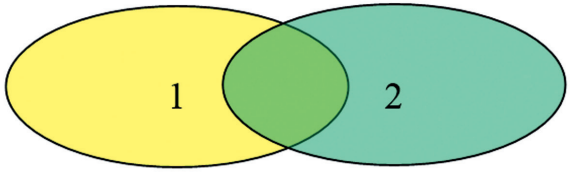
into account the opinion of the Chairman. They are largely independent of it. Their frequency of voting "for" and "against" corresponds with their internal attitude towards the law and their confidence in the correctness of their decision. Another part of the deputies does not have or does not want to have its opinions and they vote as the Chairman does. They do not manifest relatively the Chairman. They are the same as he is with respect to the observers. And finally, the third part of the deputies votes "against" the Chairman. Always against (almost always) what he says. So, relatively some external force (embodied in the Chairman) "I agree" is the same voting, "I disagree" – the opposite. Deputies have their opinions, they oscillate between these extremes, they are close to one or the other, but they mostly proceed from their attitude. In addition, there are groups of "close" deputies (the faction) who pay attention to (or ignore) the Chairman, trying to vote the in same way. They are "close" and to a large extent "identical" deputies.

It turns out that the introformation is something that identifies material objects; something that is not the same within different objects; something that forms the manifestations of one object relatively the other; something that sets the attitude towards the reality (to another introformation which manifests itself in the states of other objects) [12, 15]. Introformation is regarded as something that "forms" the differences of material objects. We can assume that **introformation is a category of difference, is the essence of relativity, the heterogeneity in Nature.**

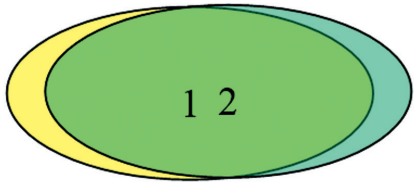
This relativity (heterogeneity) is the consequence of the sameness or difference of material objects. And this, in its turn, is set by their introformational content. Measure of heterogeneity can be determined by the degree of sameness/ difference of material objects and, accordingly, the frequency of match/ mismatch of their manifestations. We represent this ratio in the form of crossed material objects (Fig.3.2).

1. Identically manifested objects of Nature are indistinguishable (2.5). If the material objects manifest in the same way all the time, it means that not only do they have the same attitude towards the reality, but also their manifestation is the result of one internal structure, one introformation. They are indistinguishable to an outside observer; they represent a single material object (Fig.3.2.D).

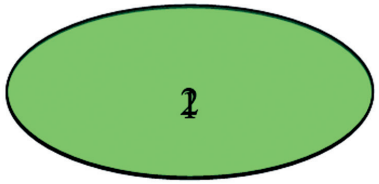
A) Opposite objects



B) Different objects. More opposite and less alike material objects



C) Different objects. More alike than opposite



D) Identical material objects

Fig.3.2. Variants of sameness/difference of material objects

Definition 3.4. If two or more material objects always manifest (displace) in the same way, they are one (inseparable) material object (superposition principle).

2. Exist means differs in motion from something that also exists (See expression 2.5). Such objects displace in the direction which is opposite to the direction of displacement of other objects. If the displacements are carried out in different directions, it means that the objects of Nature are manifested differently, and they are **different material objects**. Their internal organisation (introformation) is partly the same, and partly different.

Definition 3.5. Different material objects are such material objects which have both alike and different manifestations (See Fig.3.2.B, C).

3. But if two material objects of Nature manifest all the time differently, then they are **antipodes**. They are **opposite objects**. They have opposed both structure and introformation.

Definition 3.6. The opposite objects are material objects which always manifest themselves differently (See Fig.3.2.A).

The set of different and opposite material objects will be called unique material objects.

Definition 3.7. Unique material objects (UMO) are the material objects, which have different manifestations (displacements) relatively each other.

The probability of displacement in the opposite directions for each pair of **unique material objects** (in accordance with the expression 2.5) is not equal to 0.

The set of unique material objects determines a quantitative measure of the Universe.

The number of different manifestations is the time of existence of UMO relatively each other. According to the author, it is the **number of manifestations of UMO** that sets the **time** of their existence! Hence, time flows differently for each pair of UMO, because each pair has "its own" number of manifestations relatively each other.

If the material object is not unique, then it has the same manifestations as another material object. Then it can't be in any way separated from the object which manifests itself in the same way. And they are the same UMO for an observer (if their manifestations are different from the manifestation of the observer). Everything, that we see, everything, that we are able to observe, is a UMO. People, planets, stars, atoms and molecules are unique material objects.

3.4. The change of introformation

The introformation is defined in the previous subsections as an internal attribute of material objects. It is the category of attitude towards the truth expressed by the direction of motion, and by the manifestation of other material objects. It cannot be transferred because it is the "property" of material object. It becomes clear why this resource does not lessen with use. As the introformation was and is the property of the object, the content of which it composes. **In the process of interaction of material object** it is not the introformation that is transmitted and that leads to the decrease of entropy, but it is the transmission of information about the "attitude towards reality" by means of manifestations of these material objects.

Rule 3.1. If the manifestation of the "attitude towards reality" of a person is different than mine, then my "attitude towards reality" should be weaken if I am almost the same as he is; and strengthen if I'm completely different than he is. And the measure of my similarity to him should decrease in this case.

Rule 3.2. If the manifestations of a person are the same as mine, then my "attitude towards reality" should strengthen if I am almost the same as he is, and weaken, if I'm completely different than he is. And the measure of my similarity to him should increase in this case.

As it follows from these rules, the entropy (the measure of uncertainty) in the process of interaction can increase (if my attitude towards reality does not coincide with the manifestation of the attitude towards reality of people who are almost like me).

Therefore, in the process of interaction it is not simply the information (which reduces the entropy), it is the different attitude towards reality that is generated; the introformation changes. Introformation is inseparable from the object itself. It cannot be transmitted. Then, what is transmitted through communication channels? Communication channels do not broadcast introformation. What do we get then from newspapers, radio and television? Newspapers, radio, and television are the manifestations (word, visual image) of the attitude towards reality of the authors of publications and broadcasts. These manifestations coincide and do not coincide with mental manifestation of introformation of every reader, listener or viewer, and this changes their attitude towards reality! And, in

accordance with the rules 3.1 and 3.2, this changes their attitude towards the manifestations or towards the authors of these manifestations.

Interaction of material objects by means of the manifestations is the processor which "adapts" introformation (attitude towards reality) to the truth (reality). Interaction is based on the constant exchange of manifestations. Match or mismatch of different manifestations of material objects change their introformation (their attitude to each other – whether they are single (uniform) or different entities).

Hereof it follows that each object, which is observed by us, has a dual material and introformational nature. Herewith, the material part of an object is its external (interactive) "cover" manifesting (showing to the World) its internal organisation (introformation). And internal organisation is its introformational (determinative) part. And it is introformation that can be defined as a measure of relativity (distinctiveness) of various objects. Understanding of introformation can be formulated as follows: **introformation is something peculiar to everything in Nature, it is an absolute measure of relativity of the physical realities that allows you to set the same and different.** Such an understanding may be the prerequisite for consideration of the physical laws of Nature through the prism of "universal" laws of change of introformation in the interaction process of material objects.

The following analogy is appropriate. The material objects are something that we see on the screen when playing a computer game: moving images of people appear and move, and moreover we could (for each game) disclose by means of observing the laws of the "world" in which they live. But we know that the state of the screen is formed by the information content of the computer (software and information base of the game). Likewise, each object is composed of material "cover" – something that appears on the screen, which is called the Universe,- and internal organisation – program, introformation – something, that manifests it on the screen. If "someone sits inside" a "puppet" and forms its manifestations then this someone is identified as introformation. And there "is" something inside the human body that forms his/her manifestations. This something is its introformational essence.

3.5. The Information for consideration. The puppet model of the World

(Prepared jointly with Natalia Teslia)

There is a World of Puppets. And all inhabitants in this world are Puppeteers. But they are not just the ordinary Puppeteers. No! These Puppeteers live inside the Puppets and manage them from inside (Fig.3.3). But nobody knows about this. Everyone thinks that only the Puppets live in this World.

Each inhabitant of the World is surrounded by the Puppets. And everybody behaves as if no one else exists but the Puppets. And each Puppet behaves in such a way as the Puppeteer it wants. A lot of Puppeteers live in this World, perhaps even more than the Puppets. Some Puppeteers are so much alike (they are in one Puppet) that it is impossible to distinguish them. And they look like one Puppet to the outsiders. If a resident of the Puppet does not agree with the other inhabitants of the Puppet, then he is expelled out of it.

The Puppeteers can see that they live in the World of Puppets, communicate with the Puppets, working with the Puppets, etc. And the researchers are investigating not the World of Puppeteers, but the World of Puppets.

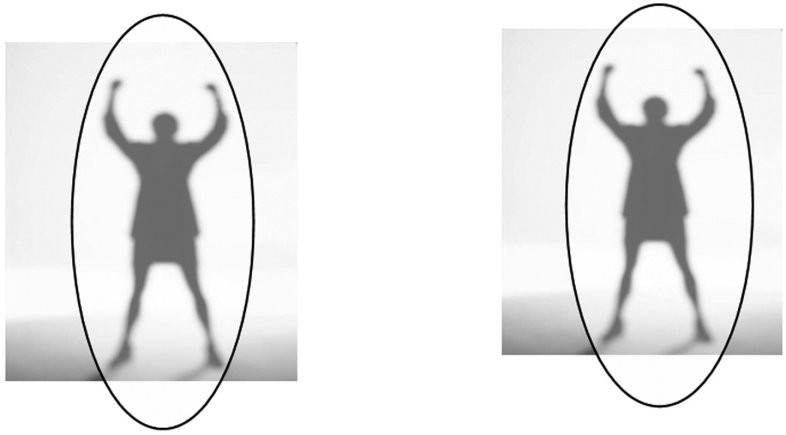


Fig. 3.3. Inhabitants of the Puppet World

Each Puppeteer plays its role. And if the Puppets, in the World that surrounds the Puppeteer behave according to their role, the Puppeteer rejoices and continues to play its role, and if not, the Puppeteer either changes the role or tries to adjust the World of Puppets according to itself.

It seems to the audience that the Puppets play the role of Puppeteers in this World. The audience sees that only the Puppets live in this World. Nobody knows about the Puppeteers, even the Puppeteers themselves. The Puppets are just a subject, material that cannot feel. The Puppets reflect the feelings and actions of Puppeteers, but the World is reflected by the Puppets. Therefore, the audience sees only the Puppets. Although ... perhaps the viewers are the Puppets, too?!

P. S. We do not want to use the terms "body" and "soul." We did not say that the inhabitants of the World of Puppets are people. We consider the invented World in which all the inhabitants live inside of what is observable, as the inhabitants of this World.

PART 4
THE INFORMATICS OF INTERACTION

Information. Our world is the World of information. World of our understanding of everything that surrounds us. It is the information obtained that determines the trajectory of our movement through life in a much greater extent than any physical interaction. There is no gravity or electromagnetic field that can explain the attraction of the people who fall in love with each other or the visit of the football match by one hundred thousand fans. Some can object me that these trajectories of motion are caused by different chemical processes in the body of fans; that we are self-managed systems, in which the behaviour of managed object is conditioned by signals from the control system. And the receipt of these signals is subject to the physical laws. But the point is that these signals are different?! Different fans have different combinations of excited neurons, leading to the same result. But the manifestations are the same, even though they are represented differently. To describe the interaction of self-managed systems' elements functional expressions which are different from those used to describe the forceful interactions are used. So far. Or perhaps the laws of interaction are universal? Let us consider this issue more carefully taking into account the introduced notion of introformation.

4.1. The Forms of Interaction

When observing the world around us, we can see that there are two forms of interaction: forceful (physical) and non-forceful (information).

For example, the police have detained a criminal, handcuffed him, and lead him by force to the police station. Then, one can see that the drunken citizen is lead home by two his colleagues. Father pulls his daughter by her hand to the kindergarten. Owner of a shepherd dog, holding it on a leash, leads it into the entrance of the house. We understand all these interactions as forceful interactions. It happens when there is an external force applied to create the necessary manifestation of counterparties of interaction (and that may be does not change their internal state). But there is another form of interaction. Traffic warden waves his/her baton and stops a driver, who has violated the traffic rules, and asks him/her to pass to a police car. And the driver lowers his/her head and follows the order of the policeman without the force coercion. The drunken citizen staggers home, accompanied by the cries of his wife, pointing his way and explaining him what to expect at home. Father promised his daughter to buy a doll, if she goes to kindergarten. And his daughter, releasing his hand, ran jumping to the kindergarten teacher. Wife shouted something to a man and a shepherd dog from the windows of the house, and they ran home ahead of each other. These are all forms of non-forceful impact on counterparties of interaction.

Non-forceful human interaction is the exchange of information through manifestations, leading to the change in introformational content. In more general terms, we can say that non-forceful interaction lies in the internal motivation of behaviour of objects of interaction – in the priority of changing the introformational content of counterparties of interaction, which leads to corresponding changes in their "behaviour" [12].

These ideas were the basis of non-forceful interaction theory, but in the monograph [12] the issue is not about the "physical non-forceful" (in the traditional sense for physics) interaction in the microcosm, neo-correlation, which is present (or absent) in the microcosm between the particles that are situated at the big distance from each other. In the theory, it has been suggested that all interactions in Nature are realized on the basis of the same principles as the human interaction is: the change of introformation leads to the change in direction and velocity of material objects.

The objects of the study of non-forceful interaction theory are the processes of formation and transformation of introformation. The author believes that introformation in Nature is the source of the interaction: this is what correlates the material objects among themselves – whether

they are the same or different relatively the direction of motion. Because if there is a different attitude (expressed by the other direction of displacement), it might be worth "listening" to it.

It is clear that forceful as well as non-forceful forms of human interaction are based on the physical processes which are typical for the self-managed systems, and on the processes, which are based on the gravitational, electromagnetic, weak and strong nuclear interactions. From the facts that the author was able to grasp from the textbooks and scientific literature in physics, it follows that the researchers understand these types of interaction as forceful ones. So, the influencing objects "change" the space-time continuum, and the objects which are influenced begin to move in accordance with the new structure of this continuum.

But has the truth of this assumption been proved? No! In fact, this assumption does not change the results of the interaction themselves, but only interprets them. Whether the result of impact is formed by influencing object or it depends on the object being impacted (whether it agrees or disagrees with the influencing object), the physical parameters of the interaction may not be changed. After all, if father leads his daughter by the hand and tells her something, it is not the obvious fact that he realizes the forceful form of influence. Maybe his verbal persuasions lead to the situation when his daughter by her choice goes with him to kindergarten, and even pulls father's hand.

4.2. Non-forceful interaction as the means of correction of introformational content of material objects

The introformation defines the manifestations of people. Motion of material substance (body) is such a manifestation. Therefore, the introformational content of people is primary. When influencing the environment a person manifests his/her thoughts, and when reflecting these manifestations, perceives him/herself. It turns out that introformation determines the work of brain, manifests it in the state of neurons, and it is not the work of brain that generates thoughts.

Each person is characterized by his/her attitude towards reality (by introformation). Non-forceful human interaction comes in the form of statements, gestures, written communications, etc. If people are different, they have different attitude towards reality, so there must be different manifestations. If they are alike, hence, they have the same attitude towards reality, so there must be the same manifestations. Manifestations that do not coincide with the attitude of people to each other, should serve as a source of "change" of their introformational content. If there is a different attitude towards reality, it might be worth accepting it. Maybe it will be more properly not to be so sure in "your" attitude, if someone is confident in reverse? In such a case, one should either change the attitude towards reality (and listen to the opinion of a close person) or change the measure of "sameness" with other people (a stranger to me expressed my thought, and so he became closer to me). In common case, both the first and the second cases should be changed in the processes of non-forceful interaction of people.

And now let us proceed to the Introformational representation of non-forceful interactions of any material objects of Nature. What is the purpose of interaction? Why does it exist in nature? We do not know. Forceful interactions change the direction and / or speed of motion. And what is the result of interaction from the position of its impact on the introformation? For this reason we will use the principle of analogy, since the purpose of work is to demonstrate compliance of essence with the role of Introformation on micro- and macro levels of Nature. Let us transfer the reasoning presented earlier to any material objects of Nature. Of course, these arguments may suit those processes that are implemented in the principles of Nature. But it is very tempting to assume that the interaction at the micro and macro levels of our Nature is subject to the same laws – the laws of Reason.

Thus, each material object is characterized by the attitude towards reality. And every material object can be the same, different and opposite to the other (the definitions 3.4-3.6). Let us introduce the rules of non-forceful interactions, which are based on the intuitive understanding of "reasonableness" of change of introformational content of the material objects:

Rule 4.1. The degree of difference / sameness of material objects must comply with the ratio of mismatches / matches of manifestations.

Conclusion 4.1. If the material objects are the same, then it means they have the same attitude towards reality, so there should always be identical manifestations.

Conclusion 4.2. If material objects are opposite (are antipodes), then it means they have the opposite attitude towards reality, therefore, there must always be different manifestations.

Non-forceful interaction provides the adjustment of internal structure (introformation) of material objects through the "comparison" of their manifestations. Manifestations that do not coincide with the attitude of material objects to each other, should serve as the source of "change" of their introformational content.

Rule 4.2. If the **rule 4.1** is not kept, then either the attitude towards reality, or the degree of mismatches / matches with other material object should change (but, probably, both) in such a way that **the rule 4.1** is kept.

Conclusion 4.3. The degree of sameness of material objects increases when the objects manifest themselves in the same way.

Conclusion 4.4. The degree of difference of material objects increases if the objects manifest themselves differently.

Let us illustrate the **rule 4.2** on the following example. The degree of difference / sameness of material objects 0.5 (should be 50% of same manifestations). But the actual number of matches is 60%. **The rule 4.1** will be satisfied if the measure of sameness is equal to, let us say, 0.55, and the matches are 55%. It is the initial discrepancy that should become the source of change (**the rule 4.2**).

The attitude of material objects towards reality is the attitude towards the direction of motion. Same material objects should manifest themselves in the same way (be one formation means always displace in one direction. ***Conclusion 4.1*** to **the rule 4.1.**). Opposite formations – always differently (be two formations means always displace in different directions. ***Conclusion 4.2*** to **the rule 4.1.**). Different material objects displace both in the same and in the different way.

But what kind of displacements can be called the same? In spite of the expressions (2.4) and (2.5) obtained in Part 2, the answer to this question is not as simple as it might have been from these expressions. Let us specify what the same manifestation is, and what is different.

There are two variants of mutual displacement: approach and drift apart of two material objects. And you can interpret their sameness also differently.

1. They are the same (one material object) due to the fact that they came out of the same starting point.

2. They long to become the same, moving to the same end point.

If one direction of motion is determined by the common end or starting point, then these points can be located behind the material objects (variants A and C – Fig. 4.1), or between them (variants B, D – Fig. 4.1).

Whether one of the stated above variants is implemented in Nature (Fig. 4.1) or different variants are implemented at different distances for different material objects, it still remains a question. But the mutual displacement of two objects is always carried out along one line (one-dimensional) and can therefore be described only by four variants represented on the Fig. 4.1. And it is not so important what kind of manifestation is formed, whether the manifestations of different material objects are the same (displacements towards the common end point or from the common starting point) or different.

Then, the purpose of interaction (in introformational interpretation) can be the determination of the directions of motion of all material objects which are relevant to each other. Summing up, we can assume that (Fig.4.2, Fig.4.3):

1. Non-forceful interaction lies in the internal "motivation" of behaviour of the object of interaction – in the primary nature of formation of the internal (introformational) content of the counterparty of interaction, leading to the changes in its behaviour (traditionally, the essence of non-forceful interaction is the external "enforcement" to change the conduct of material object under the influence of external force and, possibly, without the change of its internal content).

2. Diversity of being is the result of existence of many attitudes towards reality, which the material objects have.

3. Material object is "the bearer" of introformation. It has the property to manifest introformation.

4. Introformational content of material object forms the sequence of its manifestations, matching or mismatching the manifestations of other material objects.

5. Displacement of material object in one of directions is the manifestation (materialization) of its introformational content.

6. Material objects are a set of material objects which are more the same than opposite.

7. The mismatch of frequency of manifestations with the degree of difference / sameness of material objects is the source of changes of their introformational content.

According to the author's opinion, the **non-forceful interaction of material objects by means of manifestations is formed by the "information processor of Nature" which works out some target value, unknown to us and creates time and space of being during this process.**

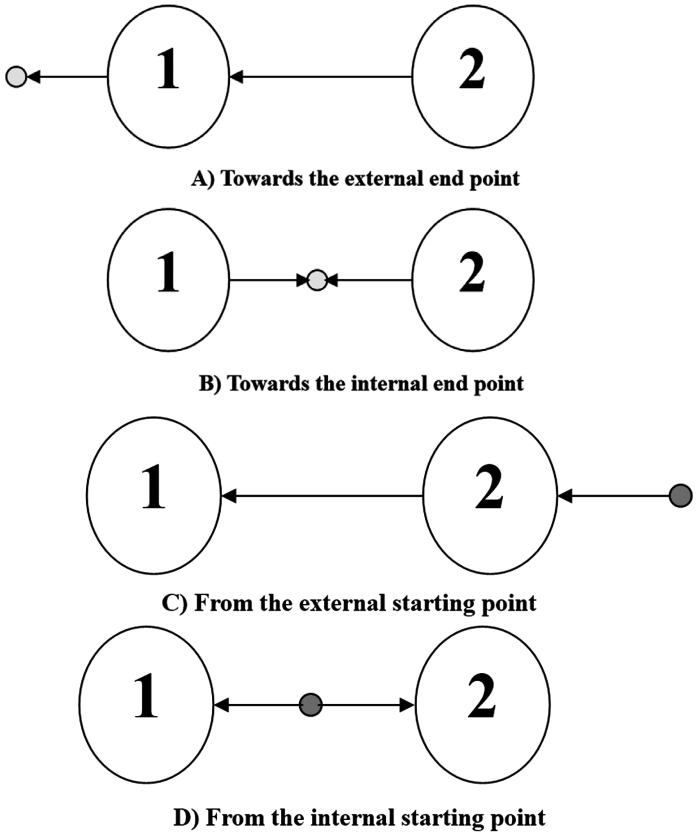


Fig.4.1. Variants of interpretation of "common" starting or end point of motion

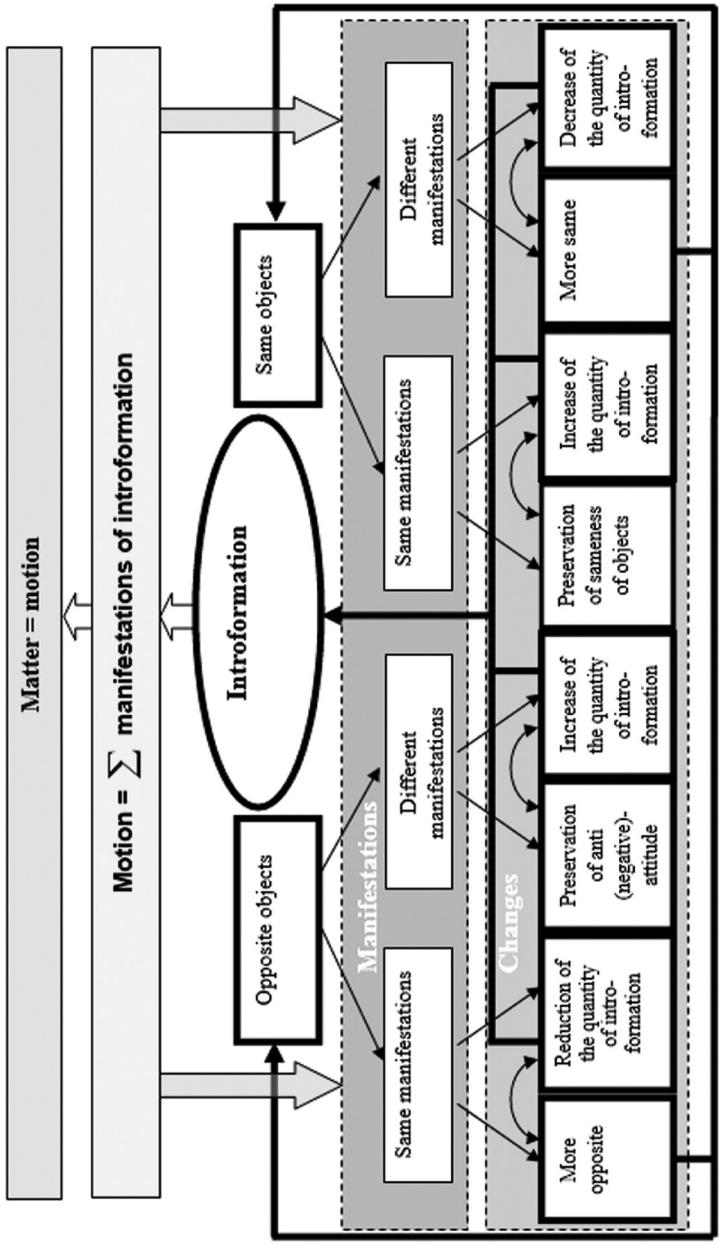


Fig.4.2. Scheme of introformation changing in the process of interaction of opposite and same objects

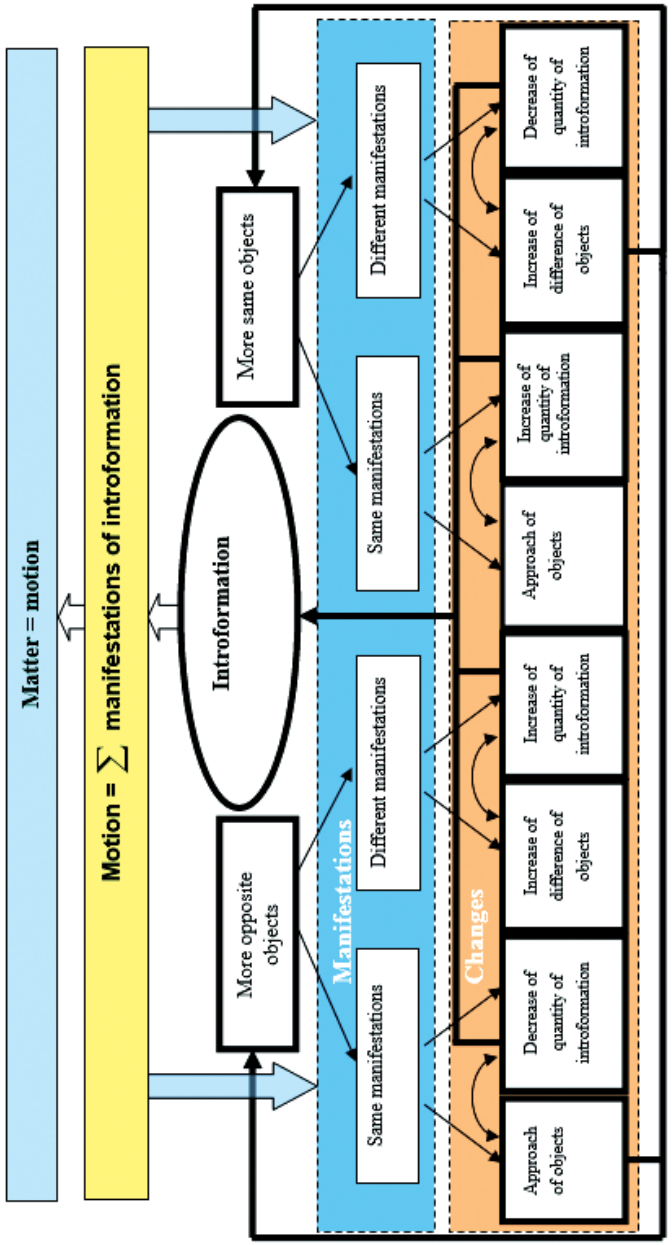


Fig.4.3. Scheme of introformation changing in the interaction process of different objects

But still, is there any purpose of interaction in the Universe? Based on the proposed understanding of essence and role of introformation in Nature, we can represent the end result of interaction as some stable (unchanging) manifestation of material objects. Though, if we assume that non-forceful character of interaction is not determined, any steady state paired with the existence of more than one material object, will sooner or later become unstable. And what if we assume that the purpose of Interaction is to eliminate the changes. In other words, make partly alike formations the same; make them become one object to eliminate their "distinctiveness." The most attractive seems to be such a final state when there are no different material objects. But it is possible that the goal is to form the opposite formations which are totally different from each other? In this case, the interaction between them is also hardly possible.

In the stated question, the author proceeded from his understanding of surrounding world, from his understanding of the causes and laws of non-forceful interaction on the micro- and macro-levels of Nature. The proposed scheme of interaction is very simple. Introformation defines the behaviour of material objects. Match / mismatch of manifestations of different material objects changes their introformational content, which in its turn leads to the new changes in their manifestation.

How can we interpret the types of forceful interaction through the proposed understanding of Nature and role of introformation in Nature? The next chapter of this work is devoted to this matter.

4.3 Non-forceful essence of interactions of different physical nature

The stated interpretation of the role of introformation in the existence of material objects changes the points of view on the nature of the forceful interactions, on the gravitational interaction in particular. General relativity explains its existence by the curvature of space, which is stronger when the object is more massive. This curvature is very often depicted with the help of a massive ball which is dropped on the flat netlike surface, which bends in the place of contact with the ball.

The ball which is not so massive and which is set on this net gets into the curvature of the net around the massive ball, changes the trajectory of motion and falls on it. In this model, both balls "behave" in such a way as they are "allowed" by the space (netlike surface). Without having any "own will". The existence of massive ball is enough to change the behaviour of less massive ball. This interaction is directed from the influencing object (massive ball) to the object of exposure (less massive ball). The result is determined by the influencing object (Fig.4.4).

Based on the proposed understanding of the role of information in Nature, a picture of the gravitational interaction can be represented differently. The result of interaction is determined not by the influencing object, but by the object being influenced. It "perceives" the calls of influencing object to the extent to which it "has the same attitude towards reality as the latter does" (Fig.4.5).

At that, it is possible that the gravitational interaction is one kind of "calls" of the influencing object. For example, the sound calls, by analogy with people. Electromagnetic is the other kind. By the same analogy, let us say, visual. Weak nuclear is the third one. For example, the sense of smell. Smells that are "heard" at close distance. And strong nuclear is the fourth one, which is perceived even closer (for example, the sense of touch).

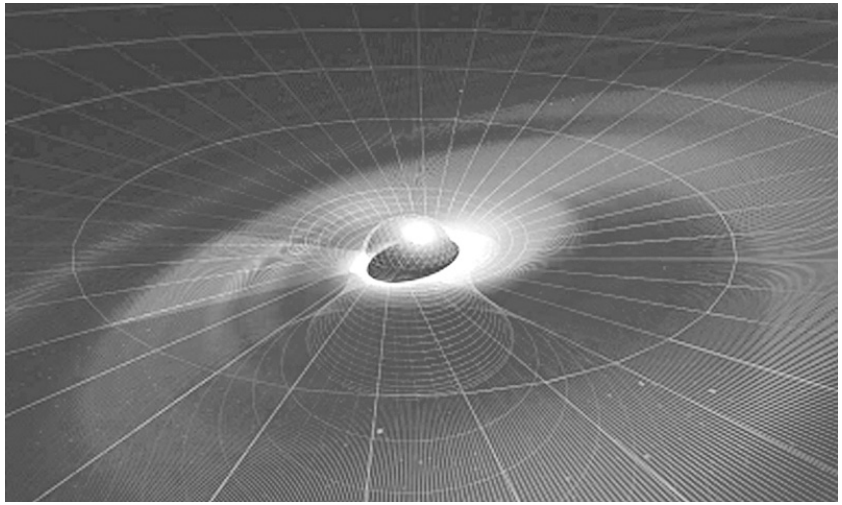


Fig.4.4. Curvature of space-time continuum by a material object

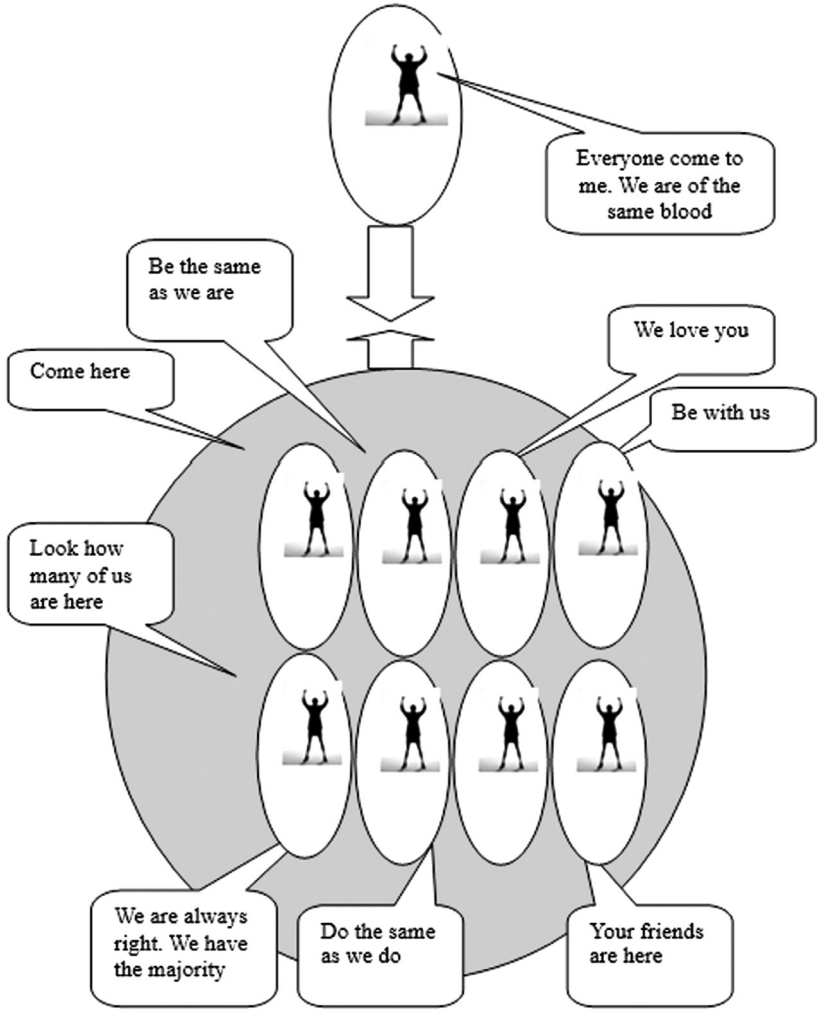


Fig.4.5. Introformational interpretation of gravitational interaction

Time in this interpretation of the processes of interaction is determined by a number of manifestations of material objects. And how can the space be represented in this case?

Perhaps the closer the material objects are to each other in space, the more they need to be in "same" manifestations (see Fig.3.2, C, D). That is, the distance between the objects is the measure of their sameness. Same attitude towards reality (towards manifestations of other objects). They represent rather a single object than different ones. At extremely short distance, they always (or with the probability which approaches to unity) manifest in the same way.

But in the absence of the distance between them, this probability becomes equal to one (in the ultimate interpretation – Interacting material objects in one area of space are one material object). Indeed, if the material objects are in the same manifestation, then it means that their introformational content allows having the same attitude towards other material objects, because a number of present material objects are the same relatively these material objects. Once again, focus our attention on the fact that material objects do not exist relatively each other in the same manifestations, and at this moment, they are not different material objects (See expressions 2.4, 2.5). If they always manifest themselves in the same way, they are one material object.

Perhaps, nothing changes in such manifestations in the Universe in the sense of "overall attitude towards reality". A material object is the single carrier of introformation in the Universe. If we assume that any two material objects have suddenly become a single object, does it mean that the quantity of introformation has been decreased? Does it mean that the "attitude towards reality" of this "composite" object is reliable to the same extent that it would have been reliable in the material object which is "a constituent" of it? It seems not. Experience shows that if some subject *Y* always says the same thing as the subject *X*, then the influence of their opinion on some question is certainly bigger than the influence of *X* only, but smaller than the influence of *X* and some *Z*, which does not always agree with *X*, but agrees with it in the question under consideration.

Hereof, the next question follows. Are all material objects the same? Perhaps, Nature consists of material objects which react differently to the impact of other material objects (like it is between humans)? Perhaps, the material objects are different computing processors which have different algorithms of change of introformational content at different / similar manifestations with other material objects? And maybe they are the same? There is no answer at the moment.

The above stated representation can be used in the Big Bang model, when all the formations of Nature composed one object (or two opposite ones). For them, there were no changes and time of existence relatively each other since they were inseparable, with the same manifestations, or (if there were two of them) incompatible with different manifestations. And only the "getting out of obedience!?" of one object of Nature could lead to the changes in other objects that were close to it, and this led to the "destruction of idyll".

Based on the proposed role of introformation in the Universe, we can conclude that non-forceful form of interaction is more suitable than forceful interaction for the role of a universal mechanism for the creation of relationships of material objects in micro-and macro-levels of Nature.

The main idea, expressed in this Part, is that the interaction of material objects in Nature lies not in forceful (external) change of direction and speed of motion, but in the change of their introformational content, which leads to the changes in behaviour. Such interaction is not the forceful interaction; it is the interaction that forms the internal order of the material object, its "introformation".

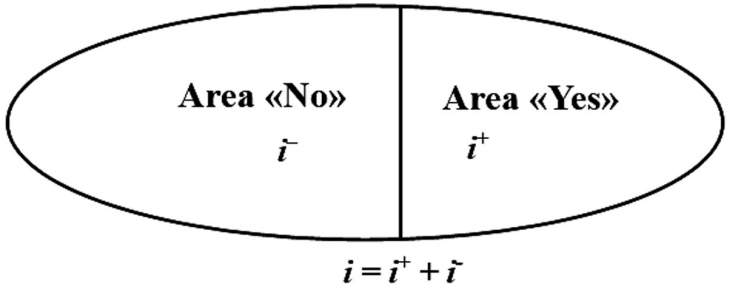
Introduction of introformation to the mechanism of interaction of material objects is quite risky, and it turns everything upside down. It looks like the relativity of material objects is primary in the mechanism of interaction. It is exactly what determines the existence of the diversity of inhomogenuity (of material objects) in Nature.

The proposed conclusions are not very useful and convincing, until they are backed up by formal mathematical apparatus. It is necessary to develop some numerical measure of the introduced category of introformation, which will be smoothly interfit with the existing physical measures. The next part of the monograph will be devoted to it.

PART 5
THE INFORMATICS OF PHYSICAL REALITIES

5.1. The *Vip* – interpretation of motion

The foreseen stochastic nature of motion (2.2) allows using the mathematical apparatus of relativity theory to construct mathematical model of a single object drift. That cannot be said about the fundamental translations. Another mathematical apparatus is needed to describe the process of formation of single displacement. Such apparatus will allow operating the transfer from the category forming the displacement (introformation), to the displacements themselves and thus "correctly" calculate the probability of displacement in either direction. If the material objects inherent stochastic nature of the displacement manifestation, the existence of the fixed space of elementary events – displacements in the direction of or in the opposite direction from the given one – can be attributed to their internal structure (Fig.2.3 and Fig.2.4 – the direction of OZ). We assume that these displacements are "generated" by introformation of each material object. This inner formation of material objects can be represented by a geometric model – two areas that define the displacement (Fig. 5.1). This is the area "Yes", containing a number of displacements in one direction, and the area "No", containing a certain number of displacements in the opposite direction. Let us assume that all displacements belong to these manifestation determination areas of the material object (Fig. 5.1).



i^+ – size of «Yes» area
i^- – size of «No» area
i – size of areas determining displacement

Fig.5.1. Areas determining displacement

How the introformation "looks like" is unknown. You cannot see the puppeteers in the puppet, and get to know their appearance (See ch. 3.5). Maybe it is some substance. It may be "natural" functionality. Or maybe its essence is hidden behind that what we understand as "organization of matter", and its roots go far into the "unknown Universe". The disclosure of the mechanisms of the "information processor of Nature" is not so important. The important thing is that we present introformation as a geometric model in the form of the displacements determination areas of any material entity (in *N*-dimensional space of *2N* areas). In this monograph we will consider the case of one-dimensional motion, and, accordingly, consider two areas determining displacement – towards and opposite to the direction of motion.

Imagine that there is some mechanism of random selection of one displacement from these areas in each moment of time. And the opportunity to choose the displacement "Yes" or "No" is proportional to the relative sizes of the areas determining displacement. Motion is the property of the object itself in this model, and not the result of forceful influence of other objects or space-time continuum curvature. Only the

ratio of the sizes of areas determining manifestations sets its own probability of displacement "for" or "against" the direction of motion.

Starting from this initial point the analytical expressions were received in the work [12] that connect the size of the areas determining displacement with the probability of displacement and velocity of material objects. But the author went even further. He assumed that the behaviour of any material objects of the Universe is formed on the same principles, and indicated:

$$i = i^+ + i^- \tag{5.1}$$

where i – size of areas determining displacement,

$$d = i^+ - i^- \tag{5.2}$$

where d – difference between areas determining displacement,

From the laws of motion (the Special theory of relativity) next mathematical dependences [31] were received by the author:

$$i = \frac{1}{\sqrt{4p - 4p^2}} = \frac{1}{2\sqrt{p - p^2}} = \frac{1}{2\sqrt{p \cdot (1-p)}}. \tag{5.3}$$

where p – probability of displacement selection from "yes" area

Inverse dependence

$$p = \frac{4i^2 \pm \sqrt{16i^4 - 16i^2}}{8i^2} = \frac{4i^2 \pm 4i\sqrt{i^2 - 1}}{8i^2} = \frac{i \pm \sqrt{i^2 - 1}}{2i}. \tag{5.4}$$

Dependence of d from i

$$d = \frac{i \pm \sqrt{i^2 - 1}}{2} - \frac{i \mp \sqrt{i^2 - 1}}{2} = \frac{2 \cdot \left(\pm\sqrt{i^2 - 1}\right)}{2} = \pm\sqrt{i^2 - 1}. \tag{5.5}$$

Inverse dependence

$$d = \pm\sqrt{i^2 - 1} \Rightarrow d^2 = i^2 - 1 \Rightarrow i^2 = d^2 + 1 \Rightarrow i = \sqrt{d^2 + 1}. \tag{5.6}$$

Dependence of d from p

$$d = \begin{cases} +0{,}5 \cdot \sqrt{\dfrac{1-p}{p} + \dfrac{p}{1-p} - 2}, at \quad 0{,}5 \le p < 1 \\ -0{,}5 \cdot \sqrt{\dfrac{1-p}{p} + \dfrac{p}{1-p} - 2}, at \quad 0 < p < 0{,}5 \end{cases} \tag{5.7}$$

And, finally, dependence of p from d and i.

$$p = \frac{i \pm \sqrt{i^2 - 1}}{2i} = \frac{i + d}{2i} = 0{,}5 + \frac{d}{2i}. \tag{5.8}$$

In order to make the assumption about the internal certainty of motion more reliable, we must find a clever, simple and beautiful explanation of the obtained dependencies, justify their appropriateness and soundness. If it is really possible to do from the standpoint of a researcher of the laws of Nature and not from the standpoint of their author. And yet, let us try to do it.

5.2. The Measures of Introformation

To describe the process of formation of a single displacement, the assumption about the existence of some internal organisation (introformation) in each material object – the initial causes of motion – was put forward.

The model of such a structure is the introduced geometric representation of the areas determining displacement. At the same time introformation is understood as a category of attitude towards the existence (in the given model towards the direction of motion of other objects). There is the manifestation of material objects in displacements (different from the displacements of other material objects), and there is something that generates these displacements. Introformation is something that forms the displacement of material objects.

The geometric model of the motion formation mechanism was represented by the random selection of displacements from two areas – agreement ("Yes") and disagreement with the truth ("No"), expressed by some direction. The proposed mathematical apparatus allows using the sizes of these areas for the calculation of probability of displacement in either direction.

From these expressions it follows that if the material object drifts in one or another direction, the size of area determining displacement in this direction is bigger than the size of area determining displacement in the opposite direction, and hence the probability of displacement in this direction is more than *0.5*. From the empirical experience, we know that if someone is moving in a direction, then either he/she wants to, or he/she is forced to do it.

It was shown in the previous Part that there are two points of view on the nature of interaction. According to the traditional point of view it is the external force that changes the direction and speed of motion. Massive material objects bend space-time continuum, and this leads to the changes in motion of surrounding material objects.

And there is the point of view which is based on the acceptance of existence in every material object of its "own" attitude towards reality (its introformation) which sets the direction and speed of motion. According to this point of view on the interaction, the motion "shows the will" of material object, which is formed by environment in the processes of non-forceful interactions. Non-forceful interaction lies in the internal motivation of motion of the object of interaction – in the priority of formation of its "internal structure", which leads to the corresponding changes in its "behaviour"(in motion) [12,15].

The author assumes that all interactions in Nature are implemented according to the second (non-forceful) scenario. And the interaction of material objects does not result in non-forceful (external) change of direction and speed, but in immediate changes of material objects themselves (size of areas determining displacement), which leads to the change in direction and speed of motion. There are no forceful interactions in this representation, and the known physical fields provide the "information" exchange between the material objects.

Real mechanism of material objects movement formation is unknown. Introformation concept is an abstract one, which reflects the existence in nature of some unknown to us mechanism of object movement in space-time continuum. But the functionality of this mechanism can be represented by this geometrical model of selection process of the material objects displacement. One displacement in space and one moment of time together are the basic unit of space-time continuum.

Introduction of a new notion and new term "introformation", which is similar to classical concept of "information", but defines its new essence as the essence that "creates" the behaviour of material objects, opens up wide opportunities for formal representations of many physical processes. In the first place – the interaction processes.

But there is another important issue here. For a formal justification of introformation motion model, it is necessary not only to discover the essence of introformation in Nature, and clarify its place in the fundamental laws, but also to find an adequate numerical expression of introformation manifestations in various physical processes and phenomena. The main drawback of the existing theories of information [9, 11, 16-24] is seen in the absence of the universal measure, the measure which could be equally used for the quantitative description of the physical processes and information processing in the self-managed systems.

Proceeding from the above presented interpretation of motion in Nature, the measure of introformation of a material object can be represented as the difference between the sizes of areas determining displacement (5.2). This difference can be referred to as the **certainty** of the material object. The sum of the sizes of areas determining displacement (5.1) can be called as **awareness** of the material object.

Thus, the attitude towards reality of material object is characterized by the dependent parameters – certainty *(d)* and awareness *(i)*:

$$l_j(K_s) = < i_j(K_s), d_j(K_s) >, \qquad (5.9)$$

where K_S – element of reality towards which the attitude is formed;
$l_j(K_S)$ – attitude of material object H_j towards the element of reality K_S;
$i_j(K_S)$ – awareness of material object H_j about the element of reality K_S;
$d_j(K_S)$ – certainty of element of reality K_S, which is defined by introformation of material object H_j.

In fact, the above calculations suggest a new interpretation of motion, which is based on the hypothesis of sameness and absolute velocity of displacement in the space of all material objects, and which combines in a single mathematical model: the velocity (***V***), informational awareness (***i***), and the probability of displacement (***p***) of these objects (***Vip***-interpretation of motion).

Definition 5.1. ***Vip***-interpretation of motion lies in its representation through the variety of displacements towards/opposite to the direction of motion with the speed equal to the speed of light in vacuum and with a probability which is determined by the introformational content of moving objects.

For those who are familiar with the physics, at least with the school course, the author cited below the computations, which show the applicability of the imposed measures to the representation of the known physical laws. Initially such task was not set in this work. It happened so that many years of reflection on the role of information in Nature and conducted computer tests have led the author to ***Vip***-interpretation of motion. Further computations easily come out from such interpretation. Let us consider them.

5.3. The Informatics of the special theory of relativity

Let us consider some of the physical laws in introformation representation and give them qualitatively new explanation. Let us demonstrate that the use of ***Vip***-interpretation of motion simplifies and makes some physical laws comprehensible and "smart". In essence, we are talking about the interpretation of physical laws within the introformation approach to understanding of the laws of Nature. For this purpose we use the achieved expressions that describe the dependences between velocity, the probability of displacement and certainty (information awareness) of material objects.

5.3.1. The Speed of Light

The special theory of relativity postulates the absoluteness of speed of light in vacuum. Regardless of how quickly we move (but at a rate less than the speed of light), we will always observe that towards the direction of motion, opposite and aside it, the light moves with constant speed *c*. There is no theory that gives a full explanation of this proven fact. It is considered that the laws of Nature are constructed so. That's all. But the postulate of the special theory of relativity about the absoluteness of the speed of light in vacuum can be obtained from the achieved ***Vip***-interpretation of the motion. Here are these computations.

Let the spacecraft *X* move to the planet *Z* with speed V_x. And a ray of light is released in the same direction from some other planet (reference point) *O*. (Figure 5.2). The astronauts have begun to measure the speed of the light ray – V_{xy}. Let us calculate it.

Indeed, from (2.3), at the speed of the light ray relatively the planet *O* $V_y = c$:

$$p_y = \frac{V_y + c}{2 \cdot c} = \frac{c + c}{2 \cdot c} = 1$$

Inserting p_y=1 in (2.5) we obtain:

$$p_{xy} = \frac{p_y \cdot (1 - p_x)}{p_y \cdot (1 - p_x) + p_x \cdot (1 - p_y)} = \frac{1 \cdot (1 - p_x)}{1 \cdot (1 - p_x) + p_x \cdot 0} = \frac{1 - p_x}{1 - p_x} = 1, \text{ (at } p_x \neq 1\text{)}.$$

Inserting in (2.2), we obtain

$$V_{xy} = (2 \cdot p_{xy} - 1) \cdot c = (2 \cdot 1 - 1) \cdot c = c$$

Thus, the speed of light relative to any object, the displacement direction of which is set with probability ($p < 1$), will always be equal to *c*. Why is it so? Moving at any speed, you can observe the light only if the displacement of the spacecraft and the light will be in opposite directions. And the spacecraft and light will be different objects only in such displacements (2.5). Therefore, in each moment of time when the light will exist relatively to the spacecraft, it will "displace" only away from the spacecraft (if you look ahead of the ship), or only to it (if you look back).

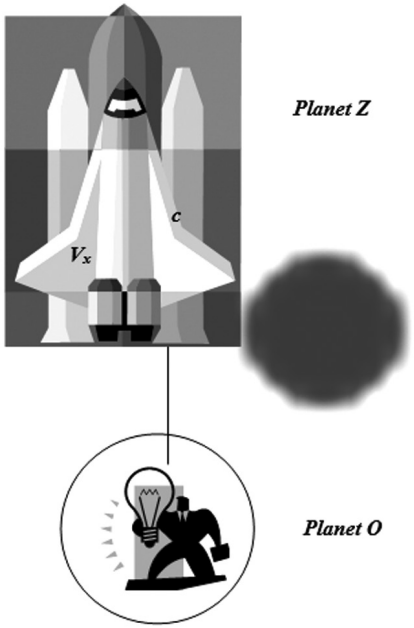


Fig.5.2. Scheme for determining the speed of light relative to the moving object

Another conclusion can be made. There is no probability greater than 1, and there cannot be speed greater than the speed of light. Indeed, from (2.2)

$$V > c \Rightarrow V = (2p-1)c > c \Rightarrow 2p-1>1 \Rightarrow p>1?$$

And where did you see the probability greater than 1? So, that is probably enough of discussions and fiction on this topic. We can never move faster than light. Motion with the speed of light corresponds to the complete confidence in something, to the full (infinite) awareness and absolute certainty in the correctness of such direction, which is not possible for material objects. We do know from our own experience that the more we know, the more awareness we have about something, and the more we realize that we know nothing. You can never be sure about anything.

In everyday life, in typical everyday situations, we know that nothing happens with probability 1 or 0. We can never predict any event or action with probability 1, no matter how much knowledge we obtain about it.

If I am not mistaken, in the 50's of last century, at the Football World Cup the U.S. team met England team. The Englishmen, the founders of football, were among the strongest in the world. And the best player of the USA team was banished from the third English league. And the Americans won – 1:0?!

Perhaps, there are a lot of such examples in various fields. And what is the basis of quantum physics. It is based on that everything in the microcosm happens with probability not equal to 0 and 1! Although they say that Albert Einstein did not accept this conclusion. And that he said something like this: "I do not believe that God, when making a decision about where to move each atom, throws dice" (I don't guarantee the accuracy, but it is the sense).

Such a probabilistic interpretation of motion unites our understanding of awareness with that what can be implemented using the physical laws of Nature.

5.3.2. Relativistic mass and time

It turns out that the awareness of material objects is equal to the Lorentz factor. In fact, we insert (2.3) in (5.3). Then,

$$i = \frac{1}{2\cdot\sqrt{p\cdot(1-p)}} = \frac{1}{2\cdot\sqrt{\frac{V+c}{2\cdot c}\cdot\left(1-\frac{V+c}{2\cdot c}\right)}} = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}}$$ – Lorentz factor.

We can obtain new expressions for the determination of relativistic mass, time, momentum and the relativistic addition of velocities.

1. Relativistic mass:

$$m = \frac{m_0}{\sqrt{1-\frac{V^2}{c^2}}} = i\cdot m_0, \qquad (5.10)$$

where m – relativistic mass of an object; m_0 – mass of an object at state of rest; i – the value of awareness.

2. Relativistic time:

$$t = \frac{t_0}{\sqrt{1 - \frac{V^2}{c^2}}} = i \cdot t_0 , \qquad (5.11)$$

where t – relativistic time of an object; t_0 – time of an object at state of rest.

Consider the expressions (5.10) – (5.11). Awareness in this expression plays the role of the universal multiplier of material objects. It is clear that there is a direct proportional dependence between the speed and probability deviation from the value of *0.5* (2.2), between the probability deviation from the values of *0.5* and awareness (5.3). Hence, the increase of total size of areas determining displacement of the material objects corresponds to the increase of speed of the material object. One possible explanation may be the following. The change of mass indicates greater reliability of introformation of the object, in which it is significant (it moves at high speed). The object at the higher speed has more introformation (is more informed). The more awareness is, the more credible it is. Less likely that it is formed accidentally. And if it is small, it is quite possible that in the interactions this value is formed accidentally. Such was an interaction environment. But if the awareness is significant, therefore, its formation has been intentional. And the probability that it reflects the "correct" attitude towards reality is significant.

5.3.3. Relativistic addition of velocities

Let us represent the formula of relativistic addition of velocities in the attributes of introformational motion model. First, let us represent the velocity through the awareness and certainty. From (2.2) and (5.8)

$$V = (2 \cdot p - 1) \cdot c = (2 \cdot \frac{i + d}{2 \cdot i} - 1) \cdot c = \frac{d}{i} \cdot c . \qquad (5.12)$$

Inserting in the formula of relativistic velocities addition the value (5.12) we obtain [12]

$$\frac{d_y}{i_y} \cdot c = \frac{d_x \cdot i_{xy} + d_{xy} \cdot i_x}{i_x \cdot i_{xy} + d_{xy} \cdot d_x} \cdot c .$$

where d_x – certainty of the object X relative to the observer;
i_x – awareness of the object X relative to the observer;
d_y – certainty of the object Y relative to the observer;
i_y – awareness of the object Y relative to the observer;
d_{xy} – certainty of the object Y relative to the object X;
i_{xy} – awareness of the object Y relative to the object X;
c – the speed of light in vacuum.

From this equation it is easy to get the value of d using the rest of the known parameters. It is done in [12] and there is no sense in repeating the process of drawing a conclusion. The result is a formula for receipt of the value of certainty that supplements the attitude towards reality of one material object to another:

$$d_{xy} = d_y \cdot i_x - d_x \cdot i_y . \qquad (5.13)$$

The inverse problem can be solved, too. If you know the attitude towards reality of any material object and additional certainty, it is possible to calculate a new attitude towards the reality of this object [12].

$$d_y = d_x \cdot i_{xy} + d_{xy} \cdot i_x . \qquad (5.14)$$

Using expressions (5.13) and (5.14) you can receive the difference in introformational contents of various objects. There is an unanswered question remaining – what will be the total change of introformational contents of the object, if it is influenced by several other objects with different additional certainty (d_{xy}). What is the sum of the impacts? In order not to reinvent the wheel, let us associate this operation with one that has been implemented in Nature long time ago. The change of quantity of motion in Nature obeys the law of conservation of momen-

tum. For this the law of conservation of momentum must be represented in a closed system from the standpoint of the supposed introformational nature of motion. That will allow defining the operation over introformation at the physical systems level. For this purpose, the momentum of a material object is considered in [12] from a position of ***Vip***-interpretation of motion in Nature. And here are the results obtained there.

5.4. Informatics of the law of conservation of momentum

Since the motion reflects the introformational content of the material object and the change in quantity of motion in the physics obeys the momentum conservation law, it would be tempting to use this law to describe the changes of introformation in a closed system of interacting objects. For operating with certainty and awareness expressions were obtained in [12], and it is shown that the momentum reflects the difference in the amount of displacements of material objects included in some object. Let us substitute (5.10) and (5.12) in the expression of the object momentum.

$$P_{\Sigma} = \sum_{j=1}^{n} m_j \cdot V_j = \sum_{j=1}^{n} m_{0j} \cdot i_j \cdot \frac{d_j}{i_j} \cdot c = c \cdot \sum_{j=1}^{n} m_{0j} \cdot d_j ,$$

where P_{Σ} – the total momentum in the closed system of material objects;

m_j – the mass of material object M_j;

V_j – the speed of material object M_j;

m_{0j} – the mass of object M_j in the state of rest;

d_j – certainty of object M_j motion;

i_j – the awareness of object M_j;

c – the speed of light in vacuum;

n – the number of material objects in the closed system.

Thus, the certainty is the momentum of material object with the correction to the speed of light. The following analogy arises**. The more a person is informed, the more confident (more defined) he/she is, relative to the category about which he/she has a lot of information (he/she has a lot of momentum), the more difficult is to convince him/her of something else (to change his/her quantity of motion).**

Making an equivalent replacement for the total momentum

$$P_{\Sigma} = c \cdot m_{\Sigma} \cdot d_{\Sigma} ,$$

where m_{Σ} – the equivalent mass at rest in a closed system of objects;

d_{Σ} – the equivalent determination in a closed system of objects.

Representing the equivalent mass at rest equal to one – $m_{\grave{a}} = 1$, we obtain:

$$d_{\Sigma} = \sum_{j=1}^{n} \sum_{l=1}^{m_{0j}} d_j = const. \qquad (5.15)$$

If we represent some object through a set of elementary objects we get:

$$d_{\Sigma} = \sum_{j=1}^{N} d_j^* = const. \qquad (5.16)$$

It turns out that a set of material objects may be replaced by one equivalent object with difference between the sizes of the areas determining manifestation which equals the total of the certainties of the objects comprising this set. In this interpretation, the law of conservation of momentum can be called the law of conservation of certainty in the set of material objects. And it can sound like this**: if the total certainty of truth in a closed system of objects is equal to some number, then any interactions in this system, leading to a change of awareness of the separate objects do not change the value of the total certainty of the truth.**

This can be illustrated by the following example. If you strongly believe in the victory of one candidate in the presidential elections and your friend is not very sure of this, during the interaction process

your confidence will decrease as a result of his convictions, and his confidence will increase, as a result of your beliefs. In the issue, total certainty will not change (your certainty is decreased as much as your friend's will increases).

So, what do we have in the end? That new information can not appear in a closed system like a community of people? Maybe! First of all, the system is not closed because of the new people who are born, and who form their attitude towards reality and interact with those who live with them. Or they will affect those who remain after (e.g., through the monograph). Secondly, people are constantly receiving new information (a new attitude towards reality is being formed) from the empirical experience, exploring the surrounding world. Third, and perhaps the most important, in the real life the main form of relationship is based not on interaction, but on influence. A professor teaches the students. A father teaches his son. A wife teaches her husband. Radio and television announcer, political scientists and commentators inspire us with their attitude towards events, thus "bringing" our attitude towards reality close to their own (Figure 5.3, a), but it does not occur in microcosm (Figure 5.3, b). From Newton's law it follows: "An action always provokes an equal reaction." There are no unilateral actions. Between people it happens.

And there is one more thing. Time is there, where there is memory, where there is a comparison with the past. This distinguishes the living matter from non-living. This distinguishes people. Only we can mark out time, compare different states which are following one after another. If people did not have memory, they could not fix the time, feel it and think about the future, and understand, identify and manipulate it in general. So, maybe there is still something in the World that we are unable to define?

Vip-interpretation of motion presented here allows looking at some physical laws in a new way, to understand and explain them. The physical categories, formed within the main physical theories of motion – the Special theory of Relativity, were researched. Not only do the obtained computations make explicit conveniences in the mathematical description of material objects' motion, but also give some reasonable explanation of the results of the Special theory of Relativity. For example, the

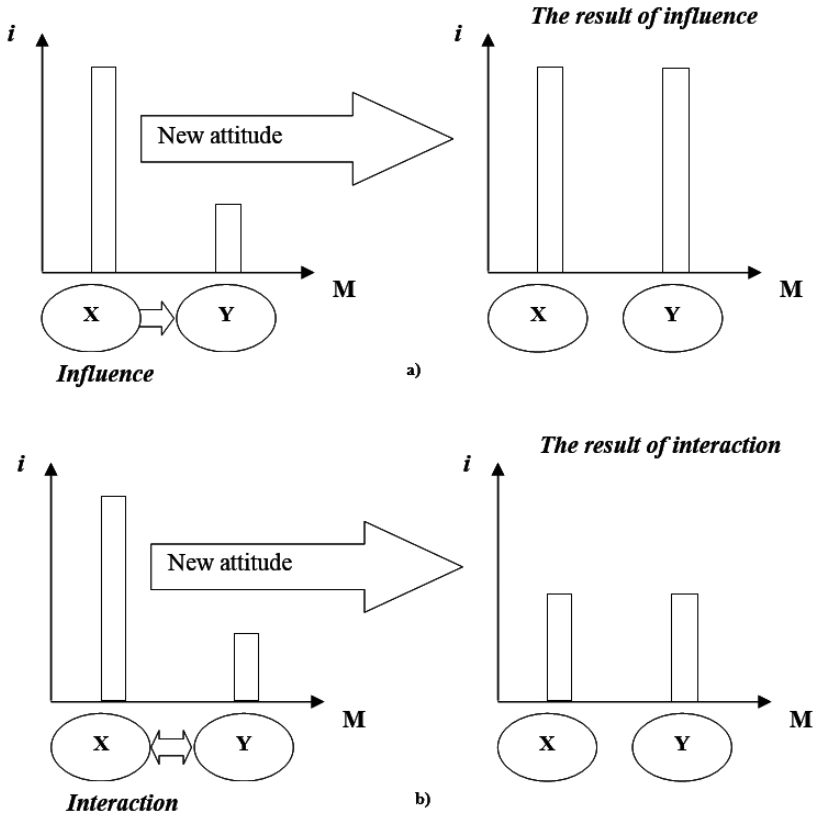


Fig.5.3. Difference between the results of non-forceful interaction and the interaction of introformational entities

explanation of the absolute speed of light is given. But there are also other elements of physics, which can be represented by introformation model's attributes, such as the uncertainty principle, Schrödinger equation, etc., that should be interesting for scientists, and may expand the boundaries of research in physics.

5.5. Are the measures and operations on introformation universal?

In the previous sections the author via the laws of physics has revealed the laws of change of material objects' internal organisation. This problem is similar to the problem of determining the operating principle of jet-propulsion unit by an aircraft flight. But perhaps, it is impossible to understand and reveal these laws in any other way.

The use of the expressions obtained within ***Vip***-interpretation of motion makes it possible to uncover the transformation laws of introformational content in Nature.

All these expressions reflect one of the key properties of Nature – the property to form the variety of states of everything in it. The bearer of this property is some internal essence of each material object, which is called introformation.

The question immediately arises. Are there any unity between the laws that form the given dependence, and the laws of human interaction? Is it only the motion of material objects described by the above equations that contain certainty and awareness as arguments, or it can be used to describe the processes occurring in the systems the activity of which is based on the usage of information? Do the obtained dependences not reflect more general laws than the physical in our Universe? And, if we use a concept close to the concept of information, to present the physical laws, is it possible to do the opposite – use the known physical dependences to operate people's awareness and certainty?

Certainty and awareness are proposed in this section as quantitative measures of introformation. The correspondence of certainty to momentum of a material object is shown, and of awareness – to Lorentz factor. From the formula of relativistic addition of velocities an expression to complement the certainty is obtained (5.14). From the law of conservation of momentum the expression, which specifies the law of conservation of certainty in a closed system of material objects, is received (5.16). Do these expressions show the deeper regularity in the structure of the Laws of Nature? Maybe these expressions can be used to calculate people's certainty? After all, perhaps, introformational

measures as the measures of attitude to the "other" in the Universe are universal for all entities and at all levels of Nature's organization. And the development of various forms of life conforms to the general laws of introformational content transformation. Perhaps, the mechanism of human intellectual activity is based exactly on introformation model, and it can be used to create artificial intelligence.

Now it is impossible to answer these questions for sure. But ***Vip***-interpretation of motion presented in this work is well-grounded, simple, intelligent, and beautiful, which indicates a high probability of its truth. And this interpretation is the basis of introformation model for the formation and manifestation of the attitude towards reality of the material objects of Nature, which we will try to use to describe the natural and artificial intelligent systems. Following Parts will be devoted to this.

And now let us consider one supposition which comes out of this work. If to assume that the rules of production of the relation to reality of the matter were formed gradually, with the development of the universe, we can assume that in the initial period of development of the Universe the correlation, presented in this part, may not be observed. It is or was set by the laws of nature from the beginning, or it was formed during the development of the matter for 13.7 billion years (according to the principle of self-organizing systems). Perhaps inanimate matter also learnt and developed [33]!

Perhaps the basis of its behavior – "reflexes" – made by training. In this case, the laws of physics, physical factors, formulae, which we interpret as a formal representation of the physical laws, are only a consequence of the development and training of the matter. And at the beginning of the universe some material objects behaved as they wanted. Perhaps, there was no gravity. Or maybe it was different. And the fact that it was created in the universe, have been reported "in its way" in the process of interaction with other entities. But then, these objects gradually learnt to build relationships with each other in such a way, that the universe evolved, and not degraded. Perhaps now in different parts of the universe there is a small deviation in the "behaviour" of the matter due to the different speed and the ability to learn?

PART 6
THE INTROFORMATIONAL METHODS

6.1. Introformational approach to formalisation of interaction in natural and artificial systems

Introformational approach, based on the idea of the nature of physical laws, is proposed to describe the functioning of systems based on the use of information in their activity. It is based on the notion that "behaviour" of all material objects of Nature (including human) is determined by their introformational content. Suggested ***Vip***-interpretation of motion, as well as the assumption of the same laws manifestation at all levels of matter organization, allows taking a fresh look at the observable world, its manifestations, its existence.

Definition 6.1. Introformational approach (an approach which is based on ***Vip***-interpretation of motion) of understanding of the laws of Nature is an approach in which the physical laws of motion and interaction are presented as derived from the transformation laws of introformational content of material objects in the information processor of Nature.

Let us introduce one more definition.

Definition 6.2. Introformational system is some physical or abstract system with the property to reveal its introformation content (attitude towards reality) by many agreements and disagreements with some truth. The frequency of agreement and disagreement with the truth in the introformational system always corresponds to its (system's) attitude towards that truth.

In the work introformational systems are proposed to be material objects of Nature.

Introduction of the concept of introformational system is made for the transition from the physical level of introformation operating to the level of organized matter, and simplifying the transformation model of introformation content by selection of only those properties that are being studied here. Further, under the term "system" we will understand exactly the introformation system, the properties of which are described at definition 6.2.

Unanswered question remains – how to handle a numerical measure (obtained in Section 5) at the level of natural and artificial intelligence systems? How does non-forceful interaction modify people's introformation? Let us combine these operations with the issues which are realized in the physical laws, and that were discussed above. **Not only do the above computations make the explicit conveniences in the mathematical description of material objects motion and give reasonable explanation for the results of the Special theory of Relativity, but also interpret certain physical laws for the benefit of Informatics**. It will allow achieving the solution of the problem defined in Part 1. Namely, search for regularities in the formation of the joint conditional probabilities by partial ones in the area of intellectual human activity.

To solve this problem let us move reverse. Let us proceed from the understanding of the mechanism of the "information processor of Nature" at the level of physical laws to the constructing of artificial systems that simulate the operation of this processor. For this purpose, it is necessary to "transfer" the obtained expressions from the physical area into the area of human intellectual activity.

Let us proceed from the position that the interaction processes at the level of objects using information in their activity (biological, social, technical forms of matter motion), must be expressed by the formulae obtained from physical laws and which are operating with introduced introformational measure. The resulting formulae will lie in the basis of certainty and awareness calculation that are peculiar to the self-managed systems.

Let us formulate the problem.

Problem 6.1. Behaviour of some system S is constructed in such a way that the action D_0 will be realized with probability p_0. But when

changing $b_j \in B, j = \overline{1,n}$ in the system, this operation is implemented with probability p_j. It is necessary to estimate the probability p_S of the action D_0 after implementing all the changes, which are included in the set B.

Let us formalize the problem statement. What does the difference in the probabilities of the action D_0 mean? It means that internal organization in the system S has changed so ($b_j\hat{I}B$) that the action D_0 is now being implemented with the probability p_j. Certainty and awareness are measures of internal organization. The measure of non-forceful action $b_j\hat{I}B$ should reflect the difference in certainty and awareness "before" and "after" the system changes. It can be affirmed that the cause of the change p_0® p_j is the change in certainty and awareness.

$d_0 \to d_j \wedge i_0 \to i_j$,

where p_0 – the probability of the action D_0 in the system S;
d_0 – certainty of the D_0 in the system S;
i_0 – awareness of the D_0 in the system S;
d_j – certainty of D_0, formed by changing $b_j\hat{I}B$;
i_j – awareness that corresponds to the certainty d_j;
p_j – the probability of D_0 when the $b_j\hat{I}B$.
At this, from (5.7) and (5.3)

$$d_0 = \pm\frac{1}{2}\sqrt{\frac{p_0}{1-p_0}+\frac{1-p_0}{p_0}-2}; i_0 = \frac{0{,}5}{\sqrt{p_0\cdot(1-p_0)}};$$

$$d_j = \pm\frac{1}{2}\sqrt{\frac{p_j}{1-p_j}+\frac{1-p_j}{p_j}-2}; i_j = \frac{0{,}5}{\sqrt{p_j\cdot(1-p_j)}}.$$

It is necessary to find a transition from the difference in the certainty of the action D_0 when accomplishing the changes $b_j\hat{I}B$ to the certainty of the action D_0 when accomplishing all changes included in the set B.

$$\forall d_j, i_j : d_0 \to d_\Sigma \wedge i_0 \to i_\Sigma \Rightarrow p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2i_\Sigma} = 0{,}5 + \frac{d_\Sigma}{2\sqrt{d_\Sigma^2+1}},$$

where d_S – certainty of action D_0, formed by all the impacts $b_j\hat{I}B$;
i_S – awareness that correspond to the d_S;
p_S – the probability of the D_0 when performing all the changes, included in the set B.

In general, the value d_Σ depends on many factors (set B).

$$d_\Sigma = f(d_0, \Delta d). \quad (6.1)$$

Proceeding from the problem 6.1 statement:

$$\Delta d_j = f(d_0, b_j),\ j = \overline{1,n}. \quad (6.2)$$

If we assume that the transition from the transformations (6.2) to transformation (6.1) is implemented in the physical laws of Nature, it will be possible to obtain an expression for operating the certainty

$$\Delta d = f(d_0, \Delta d_1, \Delta d_2, ..., \Delta d_j, ..., \Delta d_n). \quad (6.3)$$

The solution of the problem is based on the mechanism of introformation changes in the natural systems and on the following considerations. The difference in velocities (the formula of relativistic addition of velocities) was interpreted as the difference in certainty and awareness of the motion direction (because the velocity is determined by the introformational content of objects). Thus, if an object changes its velocity in some direction, it means that its introformational content has changed. But to what extent? And what is the law that changes introformational content of material objects when they interact? The answer to these questions can be obtained by studying the laws of velocity variation and the direction of objects' motion during their interaction.

6.2. How does Nature operate with introformation?

When considering the motion, impacts $b_j\hat{I}B$ always lead to the changes of speed and / or direction. The changes in the speed of motion and / or direction are always accompanied by the changes of momentum and kinetic energy. Therefore, we will look for the functional dependence (6.3) in the laws of conservation of momentum and energy.

To do so, let us represent task 6.1 as a physical one.

Problem 6.2 (physical analogue of the problem 6.1). The object of the single mass at rest S under the impact $b_j \in B, j = \overline{1,n}$ accelerates (decelerates) from the velocity V_0 to V_j. What will be the velocity of the object S, if all the actions of the set B are implemented?

Problem 6.3 (physical analogue of the problem 6.1). Proton moves with a velocity V_0. Receiving a portion of energy W_1, it will accelerate to V_1. If it receives a portion of energy W_2, it will accelerate to V_2. What will be the velocity of the proton, if it receives a portion of energy equal to W_1+W_2?

Vip-interpretation of motion is the basis for models of physical laws construction, where the introformational content of material objects plays a major part. The model of formation and manifestation of the material objects' attitude towards reality developed using the ***Vip***-interpretation of motion and presented in work [31], which uses the described concept of introformation and dependences obtained from the physical laws, is called introformation model.

Definition 6.3. Introformational model is the formalized simplified description of transformation of the material objects' internal organisation in their manifestations, which is based on the mathematical formalization of the ***Vip***-interpretation of motion.

The methods of introformation operating are developed on the basis of introformational models. These methods are based on the use of operations on introformation, implemented in the laws of Nature (the laws of conservation of momentum and energy) for the determination of total non-forceful influence and appropriate response to this impact of intellectual system in some applied areas of human activity. They were called introformational as they are based on the introduction of certainty and awareness as measures of introformation to physical formulae.

Definition 6.4. Introformational methods are the methods for the calculation of changes in the introformational content of material objects that correspond to the physical laws of Nature.

Proceeding to ***Vip***-interpretation in the solution of "physical" problems 6.2 and 6.3, the expressions, corresponding to physical laws and specifying the dependence (6.3), were obtained [31].

1. Introformational representation of the objects' momentum change.

$$\Delta d^P = \sum_{j=1}^{n}(d_j \cdot i_0 - d_0 \cdot i_j) = \sum_{j=1}^{n} d_j \cdot i_0 - \sum_{j=1}^{n} d_0 \cdot i_j = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j \,, \qquad (6.4)$$

where Δd^P - the total increment of the certainty of the system action obtained from the law of conservation of momentum.

2. Introformational representation of the kinetic energy changes

$$\Delta d^E = \begin{cases} \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}, at \operatorname{sgn}\left(\sum_{j=1}^{n}\left(d_j \cdot i_0 - d_0 \cdot i_j\right)\right) \geq 0; \\ -\sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}, at \operatorname{sgn}\left(\sum_{j=1}^{n}\left(d_j \cdot i_0 - d_0 \cdot i_j\right)\right) < 0, \end{cases} \qquad (6.5)$$

where Δd^E – the total increment of the certainty of the system action obtained from the law of conservation of energy;

$$\alpha = \sum_{j=1}^{n}\left[\operatorname{sgn}(d_j \cdot i_0 - d_0 \cdot i_j) \cdot \frac{\left(d_j \cdot i_0 - d_0 \cdot i_j\right)^2}{\sqrt{\left(d_j \cdot i_0 - d_0 \cdot i_j\right)^2 + 1}}\right]. \qquad (6.6)$$

So, there are expressions that interpret some of the physical laws in terms and attributes of informatics. There are assumptions about the absoluteness of Nature laws that form the processes of transformation of its introformation content. Thus, if Nature operates introformation at the micro level, is it possible to transfer its "experience" and laws in the fields of human intellectual activity? To do so, Let us proceed from the material objects motion to the situations in the human intellectual activity areas. Let us use these expressions to describe the transformations of introformational content in the natural and artificial intelligent systems.

6.3. Introformation operating methods

Introformation model of the laws of conservation of momentum and energy proposed in [31] makes it possible to get the result of in-

teraction all together by monitoring the interaction of objects pairs. Of course, it is important to connect the specific situation to one or another variant of the solution while solving the examples in the human intellectual activity areas. Let us consider the methods that will allow implementing the obtained introformation representation of the laws of Nature in the artificial systems.

Let us go back to the problem 6.1. It represents a probabilistic behaviour of introformational system *S*, where D_0 action is realized with the probability p_0. But by the changes (impacts on the system) $b_j \in B, j = \overline{1,n}$, action D_0 of system *S* is implemented with the probability p_j. It is necessary to estimate the probability p_S of D_0 under all changes (impacts on the system) included in the set *B*. On the basis of the above interpretation of the physical laws, we can propose the following methods of operating introformation at the artificial systems' level. These methods differ only with basic transformation model of introformation. It is the change in objects momentum during their direct interaction in method 1. In Method 2 – the change of kinetic energy in the process of influencing some object. Implementing of introformational methods is represented as consistent execution of the following calculations:

1. From the known probabilities of the manifestations (actions) of the system, its certainty (5.7) is calculated with respect to these manifestations (actions). Denote

$p_0 -$ unconditional probability of action D_0;

$p_j = p(D_0 / b_j) -$ probability of system's action D_0, under condition that changes were performed (action upon system) b_j.

$$d_j = \begin{cases} +0{,}5 \cdot \sqrt{\dfrac{p_j}{1-p_j} + \dfrac{1-p_j}{p_j} - 2}, & p_j \geq 0{,}5 \\ -0{,}5 \cdot \sqrt{\dfrac{p_j}{1-p_j} + \dfrac{1-p_j}{p_j} - 2}, & p_j < 0{,}5 \end{cases}, j = \overline{0,n},$$

where d_j – system's action D_0, under condition that changes were performed (action upon system) b_j.

2. Awareness is calculated under known system certainty (5.6)

$$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n},$$

where i_j – system awareness that corresponds to certainty d_j.

3. The calculation of total increment of system action certainty, under all actions upon the system. Using:

3.1. *Method 1.* Introformational representation of objects momentum changes (6.4)

$$\Delta d^P = \sum_{j=1}^{n} (d_j \cdot i_0 - d_0 \cdot i_j) = \sum_{j=1}^{n} d_j \cdot i_0 - \sum_{j=1}^{n} d_0 \cdot i_j = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j, \quad (6.7)$$

where Δd^P – total increment of system action certainty that obtained from the law of conservation of momentum.

3.2. *Method 2.* Introformation representation of the kinetic energy change (6.5)-(6.6)

$$\Delta d^E = \begin{cases} \sqrt{\dfrac{\alpha^2}{2} + \sqrt{\dfrac{\alpha^4}{4} + \alpha^2}}, \text{ if } \operatorname{sgn}\left(\sum_{j=1}^{n} \left(d_j \cdot i_0 - d_0 \cdot i_j \right) \right) \geq 0 \\ -\sqrt{\dfrac{\alpha^2}{2} + \sqrt{\dfrac{\alpha^4}{4} + \alpha^2}}, \text{ if } \operatorname{sgn}\left(\sum_{j=1}^{n} \left(d_j \cdot i_0 - d_0 \cdot i_j \right) \right) < 0, \end{cases} \quad (6.8)$$

where Δd^E – total increment of system action certainty obtained from the law of conservation of energy;

$$\alpha = \sum_{j=1}^{n} \left[\operatorname{sgn}(d_j \cdot i_0 - d_0 \cdot i_j) \cdot \frac{(d_j \cdot i_0 - d_0 \cdot i_j)^2}{\sqrt{(d_j \cdot i_0 - d_0 \cdot i_j)^2 + 1}} \right]. \quad (6.9)$$

Formulae (6.7)-(6.9) specify functional dependence (6.3) which is what has been required to obtain in this part.

4. Calculation of system awareness increment (5.6)

$$\Delta i^P = \sqrt{\Delta d^{P^2} + 1}; \Delta i^E = \sqrt{\Delta d^{E^2} + 1},$$

where Δi^P – system awareness increment obtained by the method 1; Δi^E – system awareness increment, obtained by the method 2.

5. Calculation of new action certainty of the system. The formula (5.14) is used

$$d_{\Sigma}^{P} = \Delta d_{\Sigma}^{P} \cdot i_0 + d_0 \cdot \Delta i_{\Sigma}^{P}; d_{\Sigma}^{E} = \Delta d_{\Sigma}^{E} \cdot i_0 + d_0 \cdot \Delta i_{\Sigma}^{E},$$

where d_{Σ}^{P} – new action certainty of the system obtained from the law of conservation of momentum; d_{Σ}^{E} – new action certainty of the system obtained from the law of conservation of energy.

6. Calculation of new action awareness of the system.

The formula (5.6) is used

$$i_{\Sigma}^{P} = \sqrt{(d_{\Sigma}^{P})^2 + 1}; i_{\Sigma}^{E} = \sqrt{(d_{\Sigma}^{E})^2 + 1},$$

where i_{Σ}^{P} – new action awareness of the system obtained from the law of conservation of momentum;

i_{Σ}^{E} – new action awareness of the system obtained from the law of conservation of energy.

7. Calculation of action probability of the system (5.8), which corresponds to the physical laws

$$p_{\Sigma}^{P} = p^{P}(D_0 / b_1,...,b_j,...,b_n) \approx 0{,}5 + \frac{d_{\Sigma}^{P}}{2i_{\Sigma}^{P}};$$

$$p^{E}(D_0 / b_1,...,b_j,...,b_n) \approx p_{\Sigma}^{E} = 0{,}5 + \frac{d_{\Sigma}^{E}}{2i_{\Sigma}^{E}},$$

where $p_{\Sigma}^{P} = p^{P}(D_0 / b_1,...,b_j,...,b_n)$ – the action probability D_0 of the system obtained from the law of conservation of momentum under condition that all changes (actions) $b_1,...,b_j,...,b_n$ will be performed;

$p_{\Sigma}^{E} = p^{E}(D_0 / b_1,...,b_j,...,b_n)$ – the action probability D_0 of the system obtained from the law of conservation of energy under condition that all changes (actions) $b_1,...,b_j,...,b_n$ will be performed.

The above methods of the joint conditional probability calculation are based on the transformation of momentum and kinetic energy; these methods also consider the changes in mass of the objects of interaction. In Part 5 it was suggested that the change in mass indicates greater probability of credibility of the introformation of the object which has it quite significant (i.e. the object is moving at high speed). But there is no such thing as mass in the human intellectual activity areas. Although

on the basis of the expected role of this magnitude in Nature (demonstration of confidence in the correctness of introformational content), it can be replaced by statistical parameters. For example, the number of tryouts (cases) used for the calculation of certainty and awareness. Of course, more tryouts give greater confidence to the obtained probabilities; hence, greater accuracy of the calculation of certainty and awareness. But this question must yet be explored.

For convenience, let us give the tabular presentation of the set of listed operations that reflect the algorithm of implementation of the described methods (table 6.1).

The idea of the above methods is that they indicate the expected "response" on impact, adequacy of which comes up from the known and experimentally verified physical laws. If the physical laws represent something more general in Nature, some common and, perhaps, reasonable laws of the Universe, then we should try to test these methods in real situations. If these methods "work" in other environments, it will become one of the arguments in favour of the intelligence of the Laws of Nature.

6.4. The problems with the use of introformational methods

Two methods for operating of certainty and awareness of material objects in the process of interaction were proposed on the basis of ***Vip***-interpretation of motion and introformational representation of physical laws. The difference in these methods is in consideration of the momentum or kinetic energy of interacting objects. Perhaps the method that is based on operating the momentum is suitable to describe non-forceful (information) interaction and the method that is based on operating the kinetic energy – for the description of non-forceful (information) impact. The author recommends examining both methods in experimental researches.

Table 6.1

Tabular representation of introformational methods

№	Operation	Transformation		Result		
		Method 1	Method 2		Method 1	Method 2
0.	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0 / b_j)\ \ j = \overline{1,n}$		p_0 p_1 p_2 p_3 p_4		
1.	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2}, j = \overline{0,n}$		d_0 d_1 d_2 d_3 d_4		
2.	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n}$		i_0 i_1 i_2 i_3 i_4		
3.	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1 $d2$ δ_3 $d4$		
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α		
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$		
4.	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di		
5.	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS		
6.	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$		
7.	New probability	$p(D_0 / b_1, ..., b_j, ..., b_n) \approx p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2i_\Sigma}$		$p\Sigma$		

But there is a slight specification. Expressions that describe operations on introformation are obtained from the ***Vip***-interpretation of motion under the statistical independence of the manifestations of objects in displacements. But as it is mentioned in Part 3, "close" material objects manifest almost identical; hence, the manifestations are statistically dependent. Perhaps, other mathematics is needed for dependent manifestations of material objects, the mathematics that takes into account the proximity (in space) of interacting objects. In this monograph, this problem was not set and solved.

There is another peculiarity of use of the obtained expressions for intelligent software systems design.

The fact is that there is synergy between various objects and processes which form events or actions in the areas of human intellectual activity. It means that the total impact is not equal to the sum of impacts. And this correction needs to be calculated and used in the algorithms of artificial intelligence systems.

These methods are not about estimation of the joint conditional probability by partial one, but about its assessment. If we assume that the laws forming the processes of introformation transformation at the level of micro formations (objects) form the process of introformation transformation at the human level in the same way, then the obtained formulae should provide some average assessment of the situation, in some cases with increment, in the other – with the decrement of such a probability. But the mathematical expectation of the actual value of the joint conditional probability must match the value that comes up from the above formulae of transformation of introformational content of material objects during their interaction.

6.5. Solution of examples

A number of examples were given in section 1.4. Let us use the developed methods for their solution.

Example 1.1. Suppose, the unconditional probability of the reaction in some situation is 0,02. For example, it is the unconditional prob-

ability that the student will pass his/her test on the discipline of "Artificial intelligence systems" with an excellent mark without training and without using lecture notes.

$$p_0 = p(A)=0{,}02;\ p_1 = p(A/B) = 0{,}08;\ p_2 = p(A/C) = 0{,}15,$$

where *p (A)* – the unconditional probability of passing the test on the discipline of "Artificial intelligence systems" with an excellent mark without training and without using lecture notes;

p (A / B) – partial conditional probability of passing the test on the discipline of "Artificial intelligence systems" with an excellent mark (under condition that the student have been training during one day);

p (A / C) – partial conditional probability of passing the test on the discipline of "Artificial intelligence systems" with an excellent mark (under condition that the student will use his/her lecture notes).

The joint conditional probability is the probability of passing the test under condition that the student has been trained during one day and will use his/her lecture notes during the test.

$$p_\Sigma = p(A / BC) - ?,$$

where *p (A / BC)* – joint conditional probability of passing the test on the discipline of "Artificial intelligence systems" with an excellent mark (assuming that the student has been trained for one day and will use lecture notes during testing).

Solution of the example is given in the table 6.2. As you can see from the Table 6.2, the discrepancy between the results obtained by two methods is insignificant.

Example 1.2.

$p(R_1/x_1) = 0{,}1;\ p(R_1/x_2)= 0{,}85;\ p(R_1/x_3) = 0{,}6.$
$p(R_2/x_1) = 0{,}9;\ p(R_2/x_2)= 0{,}15;\ p(R_2/x_3) = 0{,}4.$
$p(R_1) = 0{,}3;\ p(R_2) = 0{,}7.$

Let us solve with respect to reaction R_1. The initial data are:

$$p_0 = p(R_1) = 0{,}3;$$
$$p_1 = p(R_1 / x_1) = 0{,}1;$$
$$p_2 = p(R_1 / x_2) = 0{,}85;$$
$$p_3 = p(R_1 / x_3) = 0{,}6.$$

Calculations concerning the reaction R_1 are presented in Table 6.3. Problem statement for reaction R_2 is directly opposite to the problem statement for reaction R_1.

Table 6.2

Tabular representation of example 1.1 solution by introformational methods

№	Operation	Transformation		Result		
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j=\overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0 / b_j)\ \ j=\overline{1,n}$		p_0	0,020	
				p_1	0,080	
				p_2	0,150	
				p_3	-	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2},\ j=\overline{0,n}$		d_0	-3,429	
				d_1	-1,548	
				d_2	-0,980	
				d_3	-	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1},\ j=\overline{0,n}$		i_0	3,571	
				i_1	1,843	
				i_2	1,400	
				i_3	-	
				i_4	-	
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	0,790
				$d2$	-	1,300
				δ_3	-	-
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	1,520
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	Δδ	2,090	1,751
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	2,317	2,016
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	-0,479	-0,660
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,109	1,198
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2 i_\Sigma}$		$p\Sigma$	0,284	0,225

Table 6.3

Tabular representation of example 1.2 solution by introformational methods (relative to reaction R_1)

№	Operation	Transformation		Result		
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j=\overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0/b_j)\ j=\overline{1,n}$		p_0	0,300	
				p_1	0,100	
				p_2	0,850	
				p_3	0,600	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2}, j=\overline{0,n}$		d_0	-0,436	
				d_1	-1,333	
				d_2	0,980	
				d_3	0,204	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j=\overline{0,n}$		i_0	1,091	
				i_1	1,667	
				i_2	1,400	
				i_3	1,021	
				i_4	-	
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	-0,727
				$d2$	-	1,681
				δ_3	-	0,668
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	1,388
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$	1,621	1,628
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,905	1,911
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	0,938	0,943
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,371	1,374
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2i_\Sigma}$		$p\Sigma$	0,842	0,843

Indeed,

$$p_0 = p(R_2) = 0{,}7;$$
$$p_1 = p(R_2 / x_1) = 0{,}9;$$
$$p_2 = p(R_2 / x_2) = 0{,}15;$$
$$p_3 = p(R_2 / x_3) = 0{,}4.$$

Calculations concerning the reaction R_2 are presented in Table 6.4.

Tables 6.3 and 6.4 show that the possibilities of these reactions are obtained with the use of both methods (introformation representation of the change of momentum and kinetic energy) are opposite. And the probability of the reaction R is greater.

Example 1.3. A student attends on average 275 lessons per year out of 500. When it was raining, he attended 15 lessons out of 50. He visited 20 out of 25 lessons of Professor Myslenko. What is the expected probability of student's presence at the lesson of Professor Myslenko if it rains?

Let us denote the probabilities obtained from the specified number of lectures visits:

$$p_0 = p(A) = \frac{275}{500} = 0{,}55;$$
$$p_1 = p(A/B) = \frac{15}{50} = 0{,}3;$$
$$p_2 = p(A/C) = \frac{20}{25} = 0{,}8;$$
$$p_\Sigma = p(A/BC) - ?.$$

Let us tabulate the calculations in Table 6.5. According to the results of calculations, the conclusion can be made – perhaps, the student will pay a visit to Professor Myslenko.

Example 1.4. The probability of flu in the autumn-winter period for adults is 0.20, among those who exercise regularly it is 5%, among teachers in secondary schools – 35%. What is the expected % of catching a flu among the teachers of physical training?

Let us formalize the problem statement:

$$p_0 = p(A) = 0{,}20;\ p_1 = p(A/B) = 0{,}05;\ p_2 = p(A/C) = 0{,}35;$$
$$p_\Sigma = p(A/BC) - ?.$$

Table 6.4

Tabular representation of example 1.2 solution by introformational methods (relative to reaction R_2)

№	Operation	Transformation		Result		
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0 / b_j)\ \ j = \overline{1,n}$		p_0	0,700	
				p_1	0,900	
				p_2	0,150	
				p_3	0,400	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j}} - 2, j = \overline{0,n}$		d_0	0,436	
				d_1	1,333	
				d_2	-0,980	
				d_3	-0,204	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n}$		i_0	1,091	
				i_1	1,667	
				i_2	1,400	
				i_3	1,021	
				i_4	-	
3	Total certainty increment	$\Delta d = = i_0 \sum_{j=1}^{n} d_j - - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	0,727
				$d2$	-	-1,681
				δ_3	-	-0,668
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	-1,388
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$	-1,621	-1,628
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,905	1,911
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	-0,938	-0,943
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,371	1,374
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2 i_\Sigma}$		$p\Sigma$	0,158	0,157

Table 6.5

Tabular representation of example 1.3 solution by introformational methods

№	Operation	Transformation		Result		
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0 / b_j)\ \ j = \overline{1,n}$		p_0	0,550	
				p_1	0,300	
				p_2	0,800	
				p_3	-	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j}} - 2, j = \overline{0,n}$		d_0	0,101	
				d_1	-0,436	
				d_2	0,750	
				d_3	-	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n}$		i_0	1,005	
				i_1	1,091	
				i_2	1,250	
				i_3	-	
				i_4	-	
3	Total certainty increment	$\Delta d = = i_0 \sum_{j=1}^{n} d_j - - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	-0,548
				$d2$	-	0,628
				δ_3	-	-
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	0,071
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$	0,080	0,270
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,003	1,036
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	0,181	0,376
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,016	1,068
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2 i_\Sigma}$		$p\Sigma$	0,589	0,676

Let us tabulate the calculations in Table 6.6. The calculations showed that the risk of flu for teachers of physical training is lower (6,2-9,2%) than that of the average people (20%).

Example 1.5. Home team gains on average 65% points in the Ukrainian Premier Football League. But if the team losses, then it gains in the next match only 45% points on average. If this team meets with the team which is higher up in the standings, it gains only 40% points on average. And finally, if there is 7 days interval between matches, then this team gains 53% points on average.

If the team plays at home after losing the previous match, which has taken place 7 days before this game, and its rival is higher up in the standings, then what is more expected – victory or defeat of such a team?

Problem Statement:

$$p_0 = p(A) = 0{,}5;\ \ p_1 = p(A/B) = 0{,}65;\ p_2 = p(A/C) = 0{,}45;$$
$$p_3 = p(A/D) = 0{,}40;\ p_4 = p(A/E) = 0{,}53;\ p_\Sigma = p(A/BCDE) - ?.$$

Note: *p (A)* = 0,5 since the victory of one team is the defeat for the opponent. And vice versa. Therefore, each team gains 50% points on average.

Let us tabulate the calculations in Table 6.7. The obtained probability indicates higher probability of victory of such a team.

Example 1.6. Carpenter Teslya works 200 days per year out of 250 workdays. He was at work only 9 days out of 45 working Mondays. But he was at work 9 times out of 10 on the payday (or prepayment day). Is he expected to come to work if the payday is Monday?

Problem Statement:

p0 = p (A) = 200/250 = 0,80 – the probability of carpenter appearance at work;

p1 = p (A / B) = 9 / 45 = 0,20 – the probability of carpenter's appearance at work on Monday;

p2 = p (A / C) = 9 / 10 = 0.90 – the probability of carpenter's appearance at work on payday;

p = p (A / BC) -? – the probability of carpenter's appearance at work if the payday is Monday.

Let us tabulate the calculations in Table 6.8. The calculations using both methods indicate that it is unlikely for the carpenter to come at work on Monday, even if Monday is a payday.

Table 6.6

Tabular representation of example 1.4 solution by introformational methods

№	Operation	Transformation			Result		
		Method 1	Method 2			Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0/b_j)\ \ j = \overline{1,n}$		p_0	0,200		
				p_1	0,050		
				p_2	0,350		
				p_3	-		
				p_4	-		
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2}, j = \overline{0,n}$		d_0	-0,750		
				d_1	-2,065		
				d_2	-0,314		
				d_3	-		
				d_4	-		
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n}$		i_0	1,250		
				i_1	2,294		
				i_2	1,048		
				i_3	-		
				i_4	-		
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	-0,860	
				$d2$	-	0,393	
				δ_3	-	-	
				$d4$	-	-	
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	-0,417	
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	Δδ	-0,467	-0,716	
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,104	1,230	
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	-1,412	-1,818	
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,730	2,075	
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2 i_\Sigma}$		$p\Sigma$	0,092	0,062	

Table 6.7

Tabular representation of example 1.5 solution by introformational methods

№	Operation	Transformation			Result		
		Method 1	Method 2		Method 1	Method 2	
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0 / b_j),\ j = \overline{1,n}$		p_0	0,500		
				p_1	0,650		
				p_2	0,450		
				p_3	0,400		
				p_4	0,530		
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2}, j = \overline{0,n}$		d_0	0,000		
				d_1	0,314		
				d_2	-0,101		
				d_3	-0,204		
				d_4	0,060		
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n}$		i_0	1,000		
				i_1	1,048		
				i_2	1,005		
				i_3	1,021		
				i_4	1,002		
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	0,314	
				$d2$	-	-0,101	
				δ_3	-	-0,204	
				$d4$	-	0,060	
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	0,047	
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$	0,070	0,220	
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,002	1,024	
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	0,070	0,220	
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,002	1,024	
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2 i_\Sigma}$		$p\Sigma$	0,535	0,607	

Table 6.8

Tabular representation of example 1.6 solution by introformational methods

№	Operation	Transformation			Result		
		Method 1	Method 2		Method 1	Method 2	
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0 / b_j),\ j = \overline{1,n}$		p_0	0,800		
				p_1	0,200		
				p_2	0,900		
				p_3	-		
				p_4	-		
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2}, j = \overline{0,n}$		d_0	0,750		
				d_1	-0,750		
				d_2	1,333		
				d_3	-		
				d_4	-		
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n}$		i_0	1,250		
				i_1	1,250		
				i_2	1,667		
				i_3	-		
				i_4	-		
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	-1,875	
				$d2$	-	0,417	
				δ_3	-	-	
				$d4$	-	-	
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	-1,494	
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$	-1,458	-1,727	
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,768	1,995	
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	-0,497	-0,662	
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,117	1,199	
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2 i_\Sigma}$		$p\Sigma$	0,278	0,224	

Example 1.7. If the word "estimate" occurs in the natural language request to the intelligence system, then its response will be the cost of work with the probability 0.75, the availability of documentation with probability 0.10, and another result with probability 0.15. If the phrase "reactor facility" occurs, then the probability that response will be the cost of work is 0.50, that the documentation is available – 0.2 and another result – 0.3. During the work of intelligent system the statistics on the results which the users need was accumulated. In 35% of cases – the cost, 30% – physical volumes, 20% – the availability of documentation and 15% – the resources needed to implement the plan. Evaluate what module is required for the implementation of the request (forming of estimated cost, defining whether there is the estimates or other), which has the words combination "reactor building" and "estimate".

Problem Statement:

p(A)=0,35; *p(B)*=0,20; *p(C)*=0,30 + 0,15 = 0,45; *p(A/D)*=0,75; *p(B/D)*=0,10; *p(C/D)*=0,15; *p(A/E)*=0,50; *p(B/E)*=0,20; *p(C/E)*=0,30; *p(A/DE)*– ?, *p(B/DE)*– ?, *p(C/DE)*– ? .

The peculiarity of this problem; there are not two but three possible outcomes. This can be interpreted as three alternative directions of displacement. And in this case it is necessary to compare pairs of these directions. Let us assume that the possibility of displacement in each direction under the combination of two directions will be proportional to the corresponding probabilities.

1. Comparison of A and B (cost of works and the documentation availability).

$$p_0 = p_{AB}(A) = \frac{0{,}35}{0{,}2 + 0{,}35} = 0{,}636;$$

$$p_1 = p_{AB}(A/D) = \frac{0{,}75}{0{,}75 + 0{,}1} = 0{,}882;$$

$$p_2 = p_{AB}(A/E) = \frac{0{,}50}{0{,}20 + 0{,}50} = 0{,}714.$$

Calculations are tabulated in Table 6.9.

2. Comparison of A and C (cost of works and physical volumes or resources).

$$p_0 = p_{AC}(A) = \frac{0{,}35}{0{,}35 + 0{,}45} = 0{,}438;$$

$$p_1 = p_{AC}(A/D) = \frac{0{,}75}{0{,}75 + 0{,}15} = 0{,}833;$$

Table 6.9

Tabular representation of example 1.7 solution by introformational methods (cost or availability)

№	Operation	Transformation			Result	
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0/b_j)\ j = \overline{1,n}$		p_0	0,636	
				p_1	0,882	
				p_2	0,714	
				p_3	-	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2}, j = \overline{0,n}$		d_0	0,283	
				d_1	1,184	
				d_2	0,474	
				d_3	-	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1}, j = \overline{0,n}$		i_0	1,039	
				i_1	1,550	
				i_2	1,106	
				i_3	-	
				i_4	-	
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	0,791
				$d2$	-	0,179
				δ_3	-	-
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	0,524
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	Δδ	0,970	0,823
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,393	1,295
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	1,403	1,222
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,723	1,579
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2 i_\Sigma}$		$p\Sigma$	0,907	0,887

$$p_2 = p_{AC}(A/E) = \frac{0{,}50}{0{,}30 + 0{,}50} = 0{,}625.$$

Calculations are tabulated in Table 6.10.

No further calculations are needed. Both methods, in both comparisons, gave the same result. Comparison (cost – documentation availability and cost – physical volumes or resources) showed a significant advantage of reaction associated with obtaining the costs. And such an intelligent system should implement the algorithm for calculating the estimated cost of the reactor facility when getting request with phrase "reactor facility" and "estimate".

But to demonstrate the algorithm for problem solving with three outcomes, let us finish the calculations.

3. Comparison of B and C (the availability of documentation and the physical volumes or resources)**.**

$$p_0 = p_{BC}(B) = \frac{0{,}20}{0{,}20 + 0{,}45} = 0{,}308;$$

$$p_1 = p_{BC}(B/D) = \frac{0{,}10}{0{,}10 + 0{,}15} = 0{,}400;$$

$$p_2 = p_{BC}(A/E) = \frac{0{,}20}{0{,}20 + 0{,}30} = 0{,}400.$$

Calculations are tabulated in Table 6.11.

Let us generalize the results; evaluate the possibility of access by the cost of (A), the availability of documentation (B) and physical volumes or resources (C), using the following formula:

$$\overline{s(r_i)} = \frac{\sum_{j \neq i}\left[\left(p(r_i) + p(r_j)\right) \cdot p_{r_i r_j}(r_i)\right]}{2\dfrac{C_m^2}{m}} = \frac{\sum_{j \neq i}\left[\left(p(r_i) + p(r_j)\right) \cdot p_{r_i r_j}(r_i)\right]}{m-1},$$

where m – the number of possible outcomes; $\overline{s(r_i)}$ – the assessment of the probability of the solution r_i selection; $p(r_i)$ – the unconditional probability of the selection of solution r_i; $p(r_j)$ – the unconditional probability of the selection of solution r_j; $p_{r_i r_j}(r_i)$ – the joint conditional probability of the selection of solution r_i with alternative solution r_j (in this paper it is obtained using introformational methods).

Table 6.10

Tabular representation of example 1.7 solution by introformational methods (cost or other)

№	Operation	Transformation			Result	
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0/b_j)\ \ j = \overline{1,n}$		p_0	0,438	
				p_1	0,833	
				p_2	0,625	
				p_3	-	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\operatorname{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2},\ j = \overline{0,n}$		d_0	-0,126	
				d_1	0,893	
				d_2	0,258	
				d_3	-	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1},\ j = \overline{0,n}$		i_0	1,008	
				i_1	1,341	
				i_2	1,033	
				i_3	-	
				i_4	-	
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	1,069
				$d2$	-	0,390
				δ_3	-	-
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n}\left[\frac{\operatorname{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}}\right]$	α	-	0,920
			$\Delta d = \operatorname{sgn}(\alpha)\sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$	1,457	1,198
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,767	1,561
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	1,248	1,012
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,599	1,423
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2i_\Sigma}$		$p\Sigma$	0,890	0,856

Table 6.11

Tabular representation of example 1.7 solution by introformational methods (documentation or other)

№	Operation	Transformation		Result		
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j=\overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0/b_j)\ \ j=\overline{1,n}$		p_0	0,308	
				p_1	0,400	
				p_2	0,400	
				p_3	-	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2}, j=\overline{0,n}$		d_0	-0,417	
				d_1	-0,204	
				d_2	-0,204	
				d_3	-	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2+1}, j=\overline{0,n}$		i_0	1,083	
				i_1	1,021	
				i_2	1,021	
				i_3	-	
				i_4	-	
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	0,204
				$d2$	-	0,204
				δ_3	-	-
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2+1}} \right]$	α	-	0,082
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	Δδ	0,407	0,291
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,080	1,042
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	-0,008	-0,118
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	1,000	1,007
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2i_\Sigma}$		$p\Sigma$	0,496	0,441

Then for method 1:

$$\overline{s(A)} = \frac{p(A)+p(B)}{m-1} \cdot p_{AB}(A) + \frac{p(A)+p(C)}{m-1} \cdot p_{AC}(A) =$$
$$= \frac{0{,}35+0{,}20}{2} \cdot 0{,}907 + \frac{0{,}35+0{,}45}{2} \cdot 0{,}890 = 0{,}605;$$
$$\overline{s(B)} = \frac{p(A)+p(B)}{m-1} \cdot p_{AB}(B) + \frac{p(B)+p(C)}{m-1} \cdot p_{BC}(B) =$$
$$= \frac{0{,}35+0{,}20}{2} \cdot 0{,}093 + \frac{0{,}20+0{,}45}{2} \cdot 0{,}504 = 0{,}189;$$
$$\overline{s(C)} = \frac{p(A)+p(C)}{m-1} \cdot p_{AC}(C) + \frac{p(B)+p(C)}{m-1} \cdot p_{BC}(C) =$$
$$= \frac{0{,}35+0{,}45}{2} \cdot 0{,}110 + \frac{0{,}20+0{,}45}{2} \cdot 0{,}496 = 0{,}205.$$

For method 2:

$$\overline{s(A)} = \frac{p(A)+p(B)}{m-1} \cdot p_{AB}(A) + \frac{p(A)+p(C)}{m-1} \cdot p_{AC}(A) =$$
$$= \frac{0{,}35+0{,}20}{2} \cdot 0{,}887 + \frac{0{,}35+0{,}45}{2} \cdot 0{,}856 = 0{,}586;$$
$$\overline{s(B)} = \frac{p(A)+p(B)}{m-1} \cdot p_{AB}(B) + \frac{p(B)+p(C)}{m-1} \cdot p_{BC}(B) =$$
$$= \frac{0{,}35+0{,}20}{2} \cdot 0{,}113 + \frac{0{,}20+0{,}45}{2} \cdot 0{,}441 = 0{,}174;$$
$$\overline{s(C)} = \frac{p(A)+p(C)}{m-1} \cdot p_{AC}(C) + \frac{p(B)+p(C)}{m-1} \cdot p_{BC}(C) =$$
$$= \frac{0{,}35+0{,}45}{2} \cdot 0{,}144 + \frac{0{,}20+0{,}45}{2} \cdot 0{,}559 = 0{,}239.$$

Let us tabulate the obtained data in Table 6.12. The conclusion is the same. It is necessary to select reaction A.

Table 6.12

Consolidated table of intelligent system's possible actions assessment (Example 1.7)

Action's assessment	Method 1	Method 2
$\overline{s(A)}$	0,606	0,586
$\overline{s(B)}$	0,189	0,174
$\overline{s(C)}$	0,205	0,240

There is hope that the given examples will allow readers to learn and further develop designed methods. One cannot overestimate their effectiveness. These are only the first designs, which should further be developed by other researchers. But even in such statement, designed introformational methods can be used to create systems that respond to one or another situation in the subject area in accordance with the laws that form the basis of our Universe. How does a human do it? Read this in the next part.

PART 7
INFORMATICS OF HUMAN AND SOCIETY

In the previous sections we have examined the fundamentals of development of information systems in Nature. Let us recall. This work is based on the assumption that the motion of material objects is formed by their internal structure (their essence, content), their introformation. Introformation is something that creates the ability (property) of material objects to form an attitude towards reality. Introformation is the category of attitude to the truth (reality). Material objects that we see around us are the introformation that is manifested by motion. Attitude towards reality is expressed through the degree of agreement / disagreement with the direction of motion. There were the measures of introformation introduced – certainty and awareness. Unit of certainty leads to the change of probability from 0,5 to 0,853553. That corresponds to the awareness which is equal to 1,414214.

The primacy of some essence which forms the behaviour of people has long been declared by religion, and philosophy. Usually this is called a soul. The author of the work goes further and gives an explanation of the existing laws of physics through the introduction of the substance, “which determines the motion” of any material objects including inanimate ones. He calls this substance the introformation. The basis of further development of non-forceful interaction theory is based on the assumption that the expressions obtained from ***Vip***-interpretation of motion are valid for the interaction of objects of animate nature. In other words, the laws of interaction at the macro level should be the same as at the micro level of Nature. Why? Let us investigate this.

7.1. Complex introformation

The most difficult problem to be solved in the process of explanation of laws and regularities, diversity of forms of being and understanding of being is to find and explain the ways of introformation transition at the elementary level of its existence (manifested in motion) to a new quality — introformation which forms the behaviour of people and which we understand as the mind.

Such a transition should be based on the process of formation of a new quality of complex matter – complex introformation. Introformation on the biological, social and technical levels of matter's motion determines the behaviour (manifestation) of self-managed systems, which people certainly belong to [25]. In fact, complex introformation of humans determines their manifestations in Nature, and creates the variety of states. And this category, according to the author, largely corresponds to what is understood under information (according to the encyclopaedia of cybernetics [10]). But then the same problem arises, which has already been mentioned. There is the classical theory of information [11,23], there is a common understanding of the term of information as messages, data and knowledge [6]. They also differ from the definition of information in the Encyclopaedia of Cybernetics and from the definition of introformation; therefore we proceed in the following way. In the next statement, under the term "information" we will understand the data obtained from outside, which form the human attitude towards reality – his/her complex introformation.

Information is something that a person receives in the process of interaction with the environment (information, messages, data, and knowledge). It changes his/her introformation. Introformation is something that is manifested in the human behaviour.

Our introformation is our feelings, emotions and thoughts that manifest our attitude towards reality and are formed in the process of non-forceful interaction with the variety of surrounding objects. Therefore, if introformation is the category of attitude towards the direction of motion and towards manifestations of displacements of other material objects, then complex introformation is the category of attitude towards reality which is formed in the environment. For example, towards a

hammer that hits the fingers. Or towards the girl passes by. Or towards the truths which are expressed in this monograph. Towards the opinion of other people, weather and television programme, the result of a football match and the result of presidential elections in Ukraine. And so on. In fact, there has been a transfer made from the one-dimensional attitude towards the truth at the micro level (towards the direction of motion), to the multidimensional attitude to the truth at the macro level (towards the existence of attitudes towards reality, the existence of "complex introformation").

Besides it, there are also other forms of interaction at the macro level. Common forms of human interaction: dialogue, gestures, behaviour, and printed materials, audio and video products. One subject of interaction in these forms generates the "desired" (associated with the objectives of impact) state of another subject of interaction. But as it is at the micro level, all these forms manifest the introformation of people.

So, we named something that determines the motion of material objects as introformation, and we named something that determines human behaviour as complex introformation. But what laws lie in the basis of the processes of introformation transformation in one or another form of representation? The author believes that the laws of introformation change both at the level of mechanical motion and in other forms of motion of matter (biological, social, technical) should be the same. The explanation is the following.

What is the purpose of life? We do not know. But we know that we must live in order to achieve it! Not only is the introformation at the level of biological objects the source of their motion, but also it ensures their survival in the hostile environment of existence. Life is accompanied by variety of interactions. And one should be able to evaluate various impacts in order to survive, whether they comply or do not comply with survival. What is the criterion for assessing the impacts? Emotions, feelings, sensations. Everything that brings pleasure gives the possibility to achieve the goal of life. Everything that brings dissatisfaction does not allow doing it.

This can be illustrated through the following scheme:

1. Everything happening in the existence of objects of inanimate nature, assists (or does not assist) their survival and should be evaluated.

2. Conformity with the goals of life is assessed through sensations, feelings and emotions. Conformity with survival gives positive sensations, feelings and emotions (positive), inconformity – dissatisfaction (negativity) with life.

3. Therefore, every object of nature wants to do only what brings (or gives) pleasure. It provides the possibility to achieve the goal of life – to live.

4. Sensations, feelings and emotions are formed under the influence of environmental factors or under the influence of one's own memory.

5. To get maximum positivity from life, we should not just expect "positive" influence of environment. We should create it. We need to influence the environment in such a way that the environment gives positive feelings, emotions and sensations, so it is necessary to predict the development of environment under or without the influence on it as accurately as possible.

6. For this purpose, the objects of animate nature have the task of forming the correct (corresponding to the purposes) reaction on the influence of environment. The environment (at least its physical component) is represented by the objects and processes which manifest introformation. Hence, the laws of its development are based on the laws of transformation of introformation. For an accurate prediction, the laws of development of the environment should be reflected in the modelling system – in the human intellectual apparatus. Thus, the elaboration of the adequate (useful) human response to the impact of environment is possible only if the prognosis of the environment development corresponds to the actual environment development. This means that the processes of non-forceful interaction in modelling (human intellectual apparatus) and modelled (environment) systems must match. Only in this case, the prognosis of the result of influence on the environment will with a large probability coincide with the result of the influence itself.

Then it turns out that the expressions obtained from ***Vip***-interpretation of motion can be used to describe the motion of matter at the biological, social and technical levels of its structure.

Perhaps, introformation in Nature is "organized" in a hierarchical manner. Such a construction of Nature ensures the creation of new structures of material objects which are capable in the process of life to model

the laws of non-forceful interaction at the higher level of organization of matter. If it is so, the entrance into the new level of representation of introformation in the Universe is secured. Into the level of complex introformation which is the essence of the intelligent matter. And then, perhaps, another level which is artificially created by this intelligent matter.

But we need to answer another question. How has the transition happened from introformation as the category of the attitude towards the direction of motion at the micro level of Nature to introformation of a human which determines the attitude towards the other categories, and not just towards the motion? For example, towards one or another politician. Towards your wife. Towards the friend. Towards learning, etc. And why should these and other changes in introformation be expressed by the same laws? We offer two points of view on the concept of transition of introformation from the micro level to the complex introformation at the macro level of Nature.

1. Biological objects are organized in such a difficult way that they begin to manifest introformation as introformation which determines the attitude not to the direction of motion, but to the various manifestations of material objects, including attitude to their structures and processes occurring in them.

2. Complex biological structures have acquired the ability to model the "informational processor of Nature" (introformation and its manifestations) at the higher level of the organization of matter.

Let us consider in detail the two concepts of transition from introformation determining the mechanical motion of material objects to introformation which forms the intelligent life.

7.1.1. Variant 1. Multidimensionality of introformation of complex material structures

Human introformation in general does not form the attitudes towards the directions of motion. It forms the attitude towards other truths. Towards the truths which characterize the change in the structures (in organisation) of material object. At the low level, it forms the attitude of material objects both to the directions of motion and towards other

material objects. But as the manifestations of complex matter are not only the displacements, but also the changes in their structure, then the attitudes of complex material objects should be built not only as the attitudes to displacement, but also as the attitudes towards the changes in the structures. And this is a new, higher level of the representation of introformation. Perhaps, the minute structural formations (objects) of Nature which include the elementary particles are "built" on this principle. But if "complex" introformation (attitude towards the structure of formations) does manifest itself at the level of material objects, then it also should obey the same laws of transformations in the process of non-forceful interaction.

When the change of introformation is set by the same laws both at the micro-level of existence of matter and at the level of functioning of its macro formations, the complication of such structures should increase the dimensionality of introformation. In the end, we can reach very complex structural formations of Nature – the living matter. But here as well, the behaviour of only those biological objects will be adequate, whose reaction to the influence of environment will match the "behaviour" of environment itself. And if the behaviour of this environment abides by certain laws, then the response of biological objects must obey the same laws. Under this variant the life of biological objects should be based on the structures working according to the same laws of introformation transformation, but only in its "multidimensional" representation. Introformation of such objects forms the attitude not towards the direction of mechanical motion, as it is at the micro level of formation of matter, but to the manifestations of other objects in the environment.

The positive side of this concept is the natural multidimensionality of introformation that is displayed by complex matter. And, accordingly, that this introformation is the objective category of Nature. It exists objectively and is manifested in complex material structures, including our minds and sensations, feelings and emotions. If such introformation objectively exists, perhaps, while it loses the ability to manifest itself in the complex material structures at their destruction, it is still preserved somewhere.

7.1.2. Variant 2. The brain as introformational processor of the organized matter

Despite the well-known character of functioning of neurons in the brain, there is no model that is convincing enough and that explains the functioning of the neuronic structures as the basis of human intellectual activity [3-4, 7]. The complexity of explaining of the neural structures' functioning, in the opinion of the author, is due to the fact that the basis of the proposed mechanism is seen by most researchers as the material process which generates the processes of information processing in the objects of animate nature. On the basis of the statements of non-forceful interaction theory, we can assume that the state of neurons and their networks is formed by their internal structure – the manifestation of introformation of these structures, i.e. the material processes are based on the same laws of non-forceful interaction, as exist in the microcosm.

Suppose that there are macro formations appeared at some stage of Nature development which can exist in two states – agreement and disagreement with respect to the states the same macro formations. Moreover, their states are formed on the basis of some internal potential, which increases or decreases by the same laws, according to which introformation changes (see Part 5). Thus we can consider the model of introformation and base of elements of its manifestation at the macro level of Nature established.

In fact, if

• a material object has something that can be called the potential of material object;

• the potential of material object generates its states;

• we can assign two values of "Agree" and "Disagree" to the states of material object;

• changes of the potential of material object in the process of interaction with the same material objects are subject to the same laws, which are obeyed by the change of introformation in the physical laws,

then:

• some new level of introformation representation in Nature is formed;

• such a potential of material object is the model of introformation;

• such a material object is the model of information processor of Nature, which realizes the displacements of material objects in directions given by introformation. But the model manifests its potential not

in the attitude towards the direction of motion, but in the attitude towards the state of the environment.

Nerve cell – a neuron – is such a material object. Neurons of the brain manifest their "internal potential", the internal organisation, their introformation. They manifest a thought, but do not form it? They simulate the operation of informational processor of Nature. But they manifest not the attitude towards the direction of motion (as it is at the micro level of Nature), but towards the manifestations of other neurons, including those which reflect the state of the environment. By means of interaction, the system of interacting neurons "represents" in the human minds the environment in the past, present or future tense due to the modelling of non-forceful interaction. Therefore, at the level of human consciousness the introformation forms thoughts, sensations, feelings, emotions, human behaviour, awareness of his/her place in Nature and the ability to affect the environment through the manifestations in the states of neurons. It is the understanding of the impact on the environment which enables a person to realize his/her individual Self, to realize his/her place in Nature as a creature, born for the sake of influencing the surrounding World.

It turns out that the neurons and their networks "set" the connection (they are the channel of communication) with the "unknown introformational World" containing our positive and negative perception of the World.

On the basis of ideas about Nature of introformation and its manifestations, the neurons should have the following properties:

• have two basic states: "Agree" (the same as another neuron has) and "Disagree" (not the same as another neuron has);

• interact (compare its manifestations) with other neurons (it must be some physical connection between neurons, which provides the possibility of mutual "correlation" of displacements);

• selection of one of the two states should be based on "internal potential" which reflects the certainty and awareness of the neuron and is changing while "comparing" the manifestations with the manifestations of other neurons in accordance with introformation model (Part 6);

• if the frequency of manifestations does not correspond to the "internal potential" (due to the match or mismatch with other neurons), then the "internal potential" changes in such a way that it matches the frequency of manifestations "set" by the manifestations of other neurons.

It is the introformation that sets its own probability of manifestation of neurons in the states of agreement and disagreement with the truth expressed by manifestations of other neurons.

There is an assumption that the change in the potential of neurons is calculated in accordance with the algorithms built on the basis of the methods stated in Part 6.

The positive side of this concept is the spiral organization of Nature. There are elementary material objects which are manifested in motion. Complex structures of such material objects which appear in various states are formed on the next turn of the spiral. At this, the laws of changing of the states are the same as the laws according to which the displacements of material objects are formed. And the model of introformation in such structures (something that is manifested in their states) becomes multidimensional, reflecting the attitude towards many characteristics of the environment. Then another spiral turn goes. And so on.

But then the nature of thoughts, sensations, feelings and emotions becomes unclear. If they do not objectively exist in Nature, and are the product of functioning of the model of informational processor of Nature, then where did they come from, where were they born?

Or maybe the decision lies in combining these two concepts?

Do the laws of introformation transformation at the micro level correspond to the laws of functioning of human intellectual apparatus? You can check it only experimentally. The eighth part of the work will be dedicated to it.

7.2. The Informatics of the human being

Let us try to investigate the possible mechanism of introformation transformation in human from the perspective of non-forceful interaction theory. Many manifestations of human introformation evoke in the counterparty of interaction the comparison with his/her attitude to these manifestations as well as with the attitude towards the source of manifestation. Therefore, we can speak of two levels of attitudes in the interaction of people:

Attitude toward the source of the utterance. Under the truth we understand the very existence of the source of utterance. It is not what is said which is important but by whom it is said.

Attitude towards the content of the utterance. Under the truth we understand something what is said in the statement. It is important what is said and not by whom.

Each of the subjects tries in the process of interaction to change something that forms the manifestations of others – their introformation – in such a way that these manifestations will correspond to their own life goals. By analogy with the micro level, there are people who "agree" with the truth expressed by the statements of another person (this is the attitude towards the manifestation). Or with another person, no matter what he/she expresses (this is the attitude towards a human). There are those who disagree. And it is so in everything and always. This is the source of changes of introformation.

Introformation is not only a source of human motion and his/her interaction, but, what is most important, it ensures the survival in the hostile environment. So, it is necessary to influence the environment and perceive the impact of environment. Disclosure of the regularities in the development of environment, prediction of the development is directly linked to achieving the main goal of life of all objects of animate nature – survival.

Probably, emotions, feelings, sensations reflect the level of correspondence of the state of human and the environment to the goal of survival. Therefore, to achieve the goal, the intellectual apparatus of a person is able to "analyse" the processes connected to the change of environment, predict the state of environment, and assess the impact of environment on his/her life.

The forecasting nature of the human activity can be based on such a mechanism of prediction, which fully abides by the laws of the environment development. And it is possible only if the laws of development are the same both for the environment and for the human intellectual apparatus.

Thus, the introformation of a person needs to be formed in accordance with the laws of environment. The main way to solve this problem is to monitor the development of the environment. In the process of observation the statistics about the relations between the impact and the development

of the environment must be accumulated. These statistics should correct the attitude of an individual towards the elements of the environment. The reaction to one or another situation is elaborated in the process of learning of people to behave correctly (according to the criterion of survival), to behave in such a way to ensure his/her survival. In this case, the impact of a person on the environment should be directed at the preservation of the "positive" responsive impact of the environment on him/her.

This approach can be called a reflex. The conditioned reflexes are produced in the process of learning, including the reflexes on the words. When some state of the elements of environment leads to the positive emotions, feelings, sensations, or eliminates the negative ones. To do this, every person is constantly and subconsciously realizes the following (or similar) algorithm of interaction:

1. Everything that happens is reflected in the intellectual apparatus of a person in stochastic relationship between the cause and the consequence. If there is X_1, then Y will be with probability p.

2. Probability allows setting a definite connection between the cause and the consequence. At the same time there is a positive (consistent with the goals of life – positive emotions, feelings, sensations) or negative (is not consistent with the goals of life – negative emotions, feelings, sensations) confirmation of this connection formed. Thus, the reflexes on the state of environment are produced and the possibility of one or another action of the human is determined.

3. The adequate response to the state of the entire environment is calculated on the basis of the attitude formed towards the state of individual elements of the environment.

A person learns in such a way. And intelligent systems that are created by people should learn in this way. But we will talk more about this in the ninth part of the work.

7.3. The Informatics of the Society

The history of society development... The history of force, war, revolution. Destroying of one part of the human community by another which

differs either physically, or geographically, or because of different faith, or because of different attitude towards the current events and processes? Where is the end of force interaction in the society? When will only those remain which bring the joy of interaction life? Interactions without the use of force. When will "the kingdom of heaven" on the Earth be?

There is reality in life, in politics, economy, science, and there is the attitude towards reality. It is this attitude that we call introformation. Introformation accompanies all the processes of our life. The life of society is the interactions, which are based on the events and statements. The events and statements form our environment as well as our internal world. They affect us, they are reality and we can react on it differently: agree or disagree with it. We can like (produce positive feelings, emotions) or dislike (generate negative feelings or emotions) it. These attitudes (agree / disagree, like / dislike) to the events (reality) and statements (virtual reality), are formed by the complex introformation. Therefore, the human interaction is based on the primary change of the internal (introformation) content of the counterparties of interaction, which, in its turn, leads to changes in their behaviour. The essence of non-forceful interaction is not in the physical change in the behaviour of contractors of interaction (take by hand and force to leave the room), but in the change of the internal state (introformational content) of the counterparty of interaction, which leads to the changes in their behaviour (ask to leave the room). In convincing of what the contractors of interaction are interested in. Non-forceful interaction is implemented through the exchange of information (connected by the expressions, gestures, and written text). Information is the manifestations of the counterparties of interaction which change introformation (attitude to the truth, to reality).

We can outline three variants of non-forceful human interaction on the basis of understanding of identification of material objects in Nature (chapters 3.3 and 4.2).

Variant 1 (totalitarian). The same counterparties of interaction have the same attitude towards reality. If one counterparty of interaction is the same as another, and has some attitude towards something that took place or could take place, the other counterparty of interaction must also have the same attitude towards it. Otherwise, they are different. If a counterparty of interaction does not have its own attitude

towards some truth (it was not informed) and the other counterparty of interaction shows its attitude towards this truth, then the counterparty of interaction that "is not informed" should form the same attitude towards the truth, because they are the same.

Variant 2 (Revolutionary). Opposite counterparties of interactions have the opposite attitude towards reality. If one counterparty of interaction does not like the other, and persuades it in its attitude to the truth, then the other counterparty of interaction will increase the opposite attitude to this truth. Because they are polar opposites. If a counterparty of interaction does not have its own attitude towards the truth (it was not informed), and the opposite counterparty of interaction manifests its attitude to the truth, then the counterparty of interaction that "is not informed" should form the opposite attitude to the truth, because these counterparties of interaction are opposite.

Variant 3 (democratic). Different counterparties of interaction have the same attitude towards some truths, and different towards the others. If the attitude of one counterparty of interaction coincides with the attitude to the reality of another counterparty of interaction, thus they become closer to each other. And vice versa. When they have different attitudes, they move away from each other.

Interaction leads to the change in the attitude towards reality. As our experience shows, the change from absolute opposition to the friendly relationships brings delight. And the change from friendship to antagonism cause negative feelings. Only those can interact who have different attitudes towards reality. If the counterparties of interaction have the same attitude towards reality, it means they have the same introformation; therefore, they have nothing new to learn in the process of interaction. And they do not change their attitude towards reality. The purpose of the interaction is to form the "correct" attitude towards the truth.

The ways to achieve this are different. If the counterparties of interaction are different (democratic), the achievement of common attitude towards reality is possible in the process of non-forceful interaction (discussion, where the truth wins). If the counterparties of interaction are opposites, it means that they have the opposite attitude towards reality. If one "likes" something, then another "does not like". In this case, the achievement of the same attitude towards reality can only be

achieved by force influence (only those will stay who think, as I do). Summary for the politicians – do not create antagonism in the society!

Let us consider the processes of non-forceful interaction in the society and expected results of such interactions.

7.3.1. The ruling authority and us (non-forceful actions of the ruling authority)

I do not think that those in power are "half-gods". But I do not think that they are "the same as everybody else" either. In some respect they are not "like everybody", since we all want to be in power (it is peculiar to humans), but they are in power, and we are not. We belong to the majority, which only affects their close environment. Family. Colleagues. Managers, subordinates. Students and teachers. Friends. Representatives of the authorities, journalists, workers of culture can affect far more people because of their professional activities, although their impact is, in many cases, of corporate nature, because they often express the attitude towards reality of superior officers. The vast majority of these effects are not of forceful nature. And they are implemented in the form of actions and statements that manifest the attitude towards reality. Statements are not less or perhaps even more important than actions. Because they do not require special expenses. And they have the same impact on the society as the actions do.

Why, then, are these impacts perceived differently? Why do we have the different attitude towards the ruling authority? What can you expect from "the people in power" in the future?

Before answering these questions from the standpoint of non-forceful interaction, let us pause to think. Can the decisions of the ruling authority in the democratic country satisfy everybody (it seems to me that even if every citizen of the country receives help from the ruling authority in the amount of 1 million hryvnas, there will still be dissatisfied, who will be willing to divide between the poorest those funds which are devoted for rich)? If we live in the democratic country, then from variant 3 of non-forceful interaction it follows that the attitude towards the actions and statements of the ruling authority will be different. Accordingly, there will be different attitudes towards the ruling authority.

How should the ruling authority act and speak to make the society exist without cataclysms?

Our attitude to the ruling authority is formed by monitoring the statements of the representatives of authorities, their actions, and by observing how their decisions influence our lives. The society can be divided into parts according to the match or mismatch of the attitudes towards the statements and actions of the ruling authority. We are one part of the society to the extent to which we have the same attitude towards the actions and statements of the ruling authority and its representatives. Political entity, which corresponds to the part of society with alike attitude towards reality, is a party. Each party has its own attitude towards reality, towards the processes in the country. The party corresponds to the attitude of the part of society towards reality. And if there were not the part of society with "its" attitude towards the process in the country, then there would not be the party with the same attitude (though it seems that the attitudes of parties in Ukraine are determined by the attitude of the party leader). Imagine that only one part of society likes all the actions and statements of the ruling authority (correspondingly other parts of society do not like or are indifferent to it). Then, in accordance with the rules of non-forceful interaction, the ruling authority will be identical with that part of society, and it will become increasingly antagonistic towards the other parts (Rules 3.1 and 3.2). Accordingly, that part of the society which "matches" the ruling authority will become more and more antagonistic towards another part of society. And vice versa.

To preserve harmony in the society, reject the possibility of antagonism's creation, the statements and actions of the ruling authority should satisfy (to be positively accepted by) different parts of society to the extent that preserves the potential for democratic development. Therefore, the ruling authority's actions should not correspond to the attitude towards reality of only one part of society. The politicians always have to care about the positive feelings and emotions of all parts of society. The difference in the attitude towards reality of different parts of society should correspond to the difference in the number of actions and statements that they "like". Politics is the art of possible, the art to "meet the views" of different parts of society. Therefore, im-

plementing smart (compromising) solutions, the ruling authority should secure the democratic (smart) development of society.

Feelings and emotions characterize the attitude of an individual towards life (including ruling authority). To ensure our respect of the ruling authority it is necessary to make us believe that the decisions of the ruling authority improve our lives. To do this: it must either be true (and everyone's attitude towards reality is built – the democracy), or we should think that it is really so. And it is very often achieved by means of deception. It is easier and cheaper to achieve. Some politicians do so. And quite often.

In totalitarian countries all the people are like one man. There is one "correct" attitude towards the truths that is formed by the country's leader. And the attitude of the majority of the population to this truth (reality) is the same as that of the country's leader. The one who has different attitude is the enemy. In the democratic country, there are different attitudes towards the truth. Democracy is the freedom of choice. Everyone has the right to act as they wish, but under the law. And the attitude of the country's leader towards reality must be the same as that of the most progressive part of society. In this case, the country's development will be determined by the attitude towards reality of this particular part of society.

7.3.2. Us and the ruling authority (non-forceful actions towards the ruling authority)

Each of us is influenced by what surrounds us. What we intersect with at work. We are influenced by the mass media. The influence on the representatives of authorities is immeasurably greater. The ruling authority is the pinnacle of the pyramid, which affects almost everything that happens in the country (and much of what is happening in the world). And these impacts are what determine the behaviour of government officials and their decisions. Made decisions are sometimes obvious, sometimes unclear. We, who are not in power, do not even have an idea about the huge number of non-forceful influences that determine the decisions of the ruling authority. In the opposition, all the processes are seen differently than in the ruling authority. The significant amount of non-forceful influences that are typical for the ruling authority are absent. And it seems that when we come to power we will do everything differently. And we

want to promise to do something that the present ruling authority cannot make. Let us go to Europe! There will not be the multi-vector policy! The ruling authority will be open and honest! We will only use market mechanisms of economic management! And then the government is selected... And here comes a huge amount of non-forceful influences, which have never been thought of before. And, it turns out that everything is not so simple. You should keep promises on the one hand. On the other hand, you cannot do it without harming either yourself, or some part of the society or the country. So, the government officials select...

The ruling authority should be one team. One whole. According to the theory of non-forceful interaction – one formation (object). And this, in fact, contradicts the "individuality" of each team member. One's own actions and thoughts should obey the actions and opinions of the individuals who have the greater influence. Hence, if I want everything be done "just as I want", it is necessary that my influences, my actions, my words determine the attitude towards reality of the one who determines the decision of the ruling authority. Of the Leader (president, prime minister, governor). Hence, the leader must think that I am the same as he is. To achieve this, I must always say what the leader wants to hear. What he himself thinks. Then the leader will have the formed thought (reflex) that we both have the same attitude towards reality. And the leader will focus on my attitude towards reality in the situations with uncertain attitude towards something that has happened or can happen. And then I'll be able to influence the leader. This is the basic principle of "entering" into power.

The governmental structures are the structures where one has to implement the decisions of higher authorities and not think and recommend their own ways of solving problems. The majority of government officials consist of real professionals. But they do not determine what should be done for the development of the country in the conditions of "manual" control. Politicians want people to "like" them (especially during the elections). What should be done is determined at the management level. The others must obey. Without thinking.

Interesting conclusions follow from the theory of non-forceful interaction. If the Subordinate says all the time to the Manager "Yes, I agree with you", then the Manager does not need such a Subordinate.

Besides, he does not need the one who keeps saying "No" either. Such Subordinates do not give any information. They do not change the Manager's attitude towards reality. They are predictable?! The manager needs the employees who can agree or disagree with him/her, when speaking about their attitude towards the decision he/she has made. This gives the most information to the Manager. And they are the ones who are his/her best advisers. I think that while hiring the employees whom he/she will interact with, the Managers should make them sign a document that they will tell the truth about their attitude to what is happening, happened or will happen in any situation.

Another conclusion. The Manager should never say his/her subordinates the possible solutions in order to get the maximum of objective information about their personal attitude to the variants of the solution from them.

Now let us consider the driving force of non-forceful interactions in the society – the interests of its members.

7.3.3. Interests

Everyone in this world is a unique individual. Everyone is born, lives and dies alone with his/her opinions, feelings and emotions. For each of us there is only one "me" and what affect this "me". Thoughts are the reaction to the influence of both worlds: an external (reality) and internal (virtually formed by our memory). Time exists only in our memory. Without the memory, we would never have managed to separate time from the physical world. Feelings and emotions are the criterion of achievement of the main goal of life – to live. If you received positive feelings or emotions – hence the goal of life is achieved. Negative is not achieved. If the event or statement evokes positive emotions or feelings in us – we want it to happen. And vice versa. We do not live for other people. We live for ourselves, creating for ourselves the positivity from life. But we take care about what happens to other people. Our feelings depend on the state of other people. From the non-forceful interaction theory, we are the same, different or opposite to other people. And if anyone of those who is almost the same as me feels badly (HIS/HER attitude towards something causes negative emotions or feelings), then I had to manifest negative emotions or feelings, because

I am almost as HE/SHE is. And I do not want this. We are almost one person with the one who manifests him/herself as I do, who gives ME the pleasure from life in these manifestations. If I feel badly because the same as ME people feel badly, then I try to influence the environment in the way not to feel badly (comfort the person who is close to ME on the manifestations, help him/her). If I feel good because someone feels good, then I try to bring joy to this person, and again, I do it because it makes ME feel good. And in this situation, to the great extent, I take care not of the one I comfort, and not of the one whom I bring joy to. I am doing everything to get no negative emotions or feelings. And to get the positive ones. Each of us appreciates only his/her own feelings and emotions. And he/she does everything for this, does everything for him/herself. No matter how cruel it appears to be.

Interests of the state are manifested through the interests of people who are in power. It is unlikely that additional funds received from the re-privatization of Kryvorizhstal brought greater benefits to the society than the losses from the negative image of the conditions of existence of business in Ukraine. It seems to me that the existent problems could be solved not by the court (with huge non-forceful impact on the investors), but by non-forceful interaction between the owners and the new authority.

Remember, you should not feed the person to help him, you should give him the tools (a fishing rod, so that he can catch the fish). Investments represent such a "fishing rod" for us. Our country is not very rich. Officials are not very agile and not very interested in its prosperity. On the basis of non-forceful interaction theory, it is easier for the public officer to obtain his/her positive feelings now, and in bigger quantities, than create future of the country which he will be rewarded in. It seems to me that one should not put one's hopes for the development of culture, sports, science, education, medicine in the state. It should be put in the rich people who should be supported, for whom there must be created the conditions for doing business, and who should be taught – the skill to create the positive emotional background, not only for the people who are close to them, but for the bigger quantity of people.

It will be rewarded, because introformation component of such a person will be connected "to the good" (because it creates the good), will be the united with that part of the "unknown of introformation World", which forms the positive attitude.

Politicians' influence on the society is enormous. Every statement and action leads to the changes in the attitude of the representatives of different parts of society towards each other. It should be taboo for the politicians to make judgments about the legality or illegality of these or those actions. If the government officials choose to take away the business of people instead of developing the economy, there will be no development. If we take everything away, we will stop. And what is more, the society (or that part which is the "same" as the ruling authority) will be set on the expropriation (and we have already seen the expropriation of expropriators). I think that **the greatest enemy of society is the politician who points to the enemy**. This applies both to the authorities and to the opposition.

Every politician defends only his/her own interests (does everything that brings him/her positive feelings and emotions, or eliminates the negative ones). Statements of the politicians have the main goal that is to ensure their own political lives. Politicians comment a lot and contradictory on the future actions and decisions, because it is easier to be liked by some part of society using promises than to do something that will be liked by the same part of society. The measure of shamelessness of any person equals to the degree of ignoring of allegations that this person thinks only about him/herself. Hence, the measure of politician's shamelessness is proportional to the degree of ignoring the allegations that he/she thinks only about his/her own political image. The measure of "humanity" of each politician is determined by the measure of losses that he/she will incur when he/she is helping someone. If a politician has helped someone and did not show it, thus he/she has showed his/her humanity.

It seems to me that the politicians are not worse than we are. But the politics is always the struggle for power, so there is always the "need" to worsen someone's situation (political opponents), for their own benefit, their own positive feelings and emotions. In this case the price of losing (the removal from the politics) is so big that the politician is

ready to "create" negative feelings and emotions to those who confront him/her, in order not to worsen his/her own situation.

In defence of the politicians we can only say one thing. That it is difficult to expect something else at the current level of "humanity" of society, the level which was formed in the "socialistic" period of education. And we, those who are not in power, once there, perhaps, would have been the same. But perhaps the time will come when the politicians themselves will not be able to break the law. Even for their own benefit. Because the violation of the law will bring for themselves such negative feelings and emotions to which they will not agree even for their own interests.

7.3.4. Ruling authority and Opposition

The change of ruling authority is the indicator of democratic society. The new authority is a priori better than the old one. There is no one who "sticks" to the power, no ballast. But it will be. And the new ruling authority will sooner or later become the old one. And we will need the new "new authority". And it is normal and good. The only thing that is not normal is that every new ruling authority does not understand that, in essence, it consists of the same people as the old one. The people, who want to be happy, live well, get only positive feelings and emotions. Remember what happened each time after replacing the country's leader: Stalin / Khrushchev, Khrushchev / Brezhnev, Brezhnev – Andropov-Chernenko/Gorbachev, Gorbachev / Yeltsin-Kravchuk, Kravchuk / Kuchma (at least), Kuchma / Yushchenko. We learned that the previous ruling authority was criminal, mediocre, etc. And those who proclaimed it became criminals, incompetents, etc according to the new leaders. Maybe it's time to end it! And understand that for the ruling authority everyone should be the same: the associates, opposition, and precursors. The question is not the mistakes that they have made. Everyone who does something makes mistakes. The question is what they did to Ukraine! And then there is a hope that the next change of the ruling authority will pass without the threat of forceful interaction. Tolerant. No black PR. And we will be pride of our Ukraine, of our leaders.

There is another problem of ruling authority. If I, being in the "team of ruling authority", point to someone from this team that HE/SHE is not like ME (not like other team members), then the other team members raises the question – whether it is HE/SHE not like THEY are, or I am not like THEY are. Because I have a different attitude towards HIM/HER, than THEY have. Do I need this? After all, it can lead to the problems. I become different from them, so I am not like THEY are. So, it means I am the same as the opposition, which means I have less opportunities to survive within the ruling authority, and thus fewer opportunities to obtain positivity from life. Hence, the basic necessity of life is violated – to survive. Then, maybe I should not manifest my (mismatching) attitude towards THOSE who are almost the same as I am (to the team members of the ruling authority). Hence, the ballast does not disappear anywhere, until the ruling authority is changed. Therefore, the new ruling authority is better than the previous not because the previous politicians are changed by the better ones, but because there is no (or less) ballast near them. And because there is a new team which comes with the new ruling authority and seeing and voicing the errors of predecessors, tries to avoid them.

7.3.5. The search of the enemy

Search of the enemy is the best way to justify own mistakes. If HE/SHE is not like I am, then he/she has a different attitude towards the truth (reality) than I have. What makes ME happy — makes HIM/HER sad. He/she feels badly, I feel good. And vice versa.

Each of us who was born and grew up under socialism, remember that an enemy was a constant companion of our lives. We were not taught to love all people. We were not explained that they were the same as we were. Religion had no significant influence. The State influenced us in such a way that we knew: the workers and peasants – are ours, the landowners and capitalists are strangers, those in GDR – ours, in Germany – strangers and so on. The world was divided. And if we "are not with ours" it means we are enemies. Our society was a society that was focused on the existence of an enemy. And the enemy cannot have the same attitude towards reality, as we have.

Search of the enemy is the leitmotif of the actions of great part of the society, and, therefore, the part of politicians. And this creates the conditions for generating the opposite attitude towards reality. For the democratic variant of interactions (variant 3), the difference between the attitudes of two teams (those in power and the opposition) should exist, but should not be antagonistic. In this case:

• going out of power does not mean the transition to the opposite state attitude towards anything that is done by the ruling authority. So, does not make harm to the "life";

• there is an opportunity for non-forceful impact with the change in the attitude of the counterparty of interaction – there is an opportunity to convince in one's own position.

If the ruling authority affirms democracy, its representatives should understand that if professing the principle of "search of the enemy", then the time will come, and there will be a new ruling authority. And then the former government becomes the "enemy". Thus, the win of politicians who "initiate" the search of the enemy is their future loss.

All politicians need to stop and realise. There are no hostile camps in Ukraine. No enemies. There are no "bandits" and "fascists" among the politicians. We all need each other. We are formed differently, have different introformation and, hence, different attitudes towards reality. We cannot and should not receive the positive feelings and emotions because someone was hurt.

What we need in our society? War (forceful interactions) or peace (non-forceful interactions)? Fighting with ourselves, we will not solve any problems. And we already have a lot of them. So, there is only one answer. The future of humanity is in non-forceful interactions. We should understand this. We should understand this for our own sake, for the sake of the Ukrainian people. To achieve this, the politicians and all citizens who support the ruling authority need to find the positive in the previous ruling authority, and in the opposition. But the opposition and everyone who supports it should admit the positivity of the present ruling authority. I think it will be good if every reader himself admits the positive features of both: the supporters and the opponents. This is the road to Peace in the society.

7.3.6. War or Peace?

Let us recall the words of Professor Preobrazhensky (Mikhail Bulgakov, "The Heart of a Dog") that the ruin does not begin in the doorways, and not on the streets but in the minds of people. Therefore, to solve our problems, it is necessary to think first of all not of what surrounds us, but of what is in our mind. Let us not change the world around us, but change ourselves in the first place, our attitude towards reality, towards life and politicians. One cannot build one's own life on receiving the positive feelings and emotions because someone has negative feelings and emotions. We are all born to be happy. For this, it is necessary to do good things and not do to others what we do not want to be done to us. We are different. But the result of non-forceful interactions is the creation of common attitude towards reality. Finding the Truth. In the form of goodness, consent and joy in life!

PART 8
EXPERIMENTAL VERIFICATION OF INTROFORMATIONAL METHODS

Of course, in real-life situations the actual joint conditional probability may be different from the one that will be obtained using the developed introformational methods (Part 6). But the idea of these methods is that they indicate the expected (average) probability, which follows from the known and experimentally verified physical laws. And if the physical laws reflect something more general in Nature, some general and, perhaps, intelligent laws of the Universe, then we should try to test these methods in real-life situations. If these methods will "work" in other environments, this will become one of the arguments in favour of the intelligence of the laws of the Universe.

So, there are expressions that interpret some of the physical laws in terms and attributes of informatics. There are assumptions about the absoluteness of Nature's laws that form the processes of introformation content's transformation of all material objects (both animate and inanimate). How can this hypothesis be tested? The main manifestation of the intellect is the language. Therefore, the most characteristic field of intellectual activity is the natural language communication. The creation of artificial intelligence systems with capability to communicate with a person in a natural language is the most challenging task of artificial intelligence. The solution of this problem is equivalent to the creation of artificial intelligence itself.

Of course, the elaboration of such systems has been conducted for a long time. There is some success in this direction. But it is hard to find a

person who has communicated with a computer using natural language or a language close to natural at least once.

There is another problem: according to the experts the cost of development of such systems is significant (estimated at millions of U.S. dollars), so it is very tempting to use methods and models that interpret the physical laws of Nature for the construction of natural language communication systems. However, first of all it is necessary to prove that the calculations by these methods correspond to the statistical regularities in natural language.

8.1. Problem statement of experimental verification of the adequacy of introformational model to the processes of natural language texts formation

Any text reflects the author's representation of reality. The rules for constructing it, in addition to the author's representation of reality, suggest that each additional piece of text depends on the previous, and can be predicted with a certain probability (Fig.8.1).

Let us represent each piece of text as a product produced by an intelligent apparatus of a person. The semantic component of text, which is the essence and the product of non-forceful (informational) interaction processes in the intellectual apparatus of a person, determines further development of the text. Under the "development of the text" we mean the adherence of new fragments to this text (Fig.8.1).

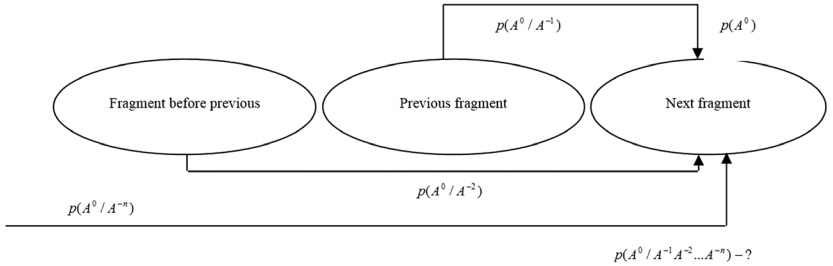


Fig.8.1. Determination of text fragment development by previous fragments.

Selection of the text fragments can be carried out in different ways. For example, a single character can be considered as an elementary fragment. Under "**the length of a text fragment**" we understand the number of characters in the text fragment.

It is more familiar to use separate words as a fragment (fragments of arbitrary length).

Let us verify correspondence between the statistical regularities of natural language texts fragments and the expressions obtained within introformational approach. To do this, let us formulate the problem as follows. **Let us determine the most probable next text fragment using absolute and partial conditional probabilities.** Let us find

$$A_k^0 \wedge p(A_k^0/A^{-1}...A^{-i}...A^{-m}) = \max_j\left(p(A_j^0/A^{-1}...A^{-i}...A^{-m})\right), j=\overline{1,n},$$

under

$$p(A_j^0),\ p(A_j^0/A^{-1}),...p(A_j^0/A^{-i}),...,p(A_j^0/A^{-m}),\ j=\overline{1,n}, \qquad (8.1)$$

where A_k^0 – the predicted (most probabilistic) text fragment;

$p(A_k^0/A^{-1}...A^{-i}...A^{-m})$ - the calculated joint conditional probability of the appearance of text fragment A_k^0;

$p(A_j^0/A^{-1}...A^{-i}...A^{-m})$ – the calculated joint conditional probability of the appearance of text fragment A_j^0;

$p(A_j^0/A^{-i})$ – the partial conditional probability of the appearance of text fragment A_j^0, if the previous fragment is A^{-i}.

The solution of this problem is based on the evaluation of the joint conditional probabilities of the text fragment appearance under partial conditional probabilities. It is impossible to get such solution in analytical form as the posterior probabilities are unknown. Such an evaluation permits constructing some intelligent software systems that are based not on heuristics (e.g., through the weighting factors), but on the mathematical apparatus of the non-forceful interaction theory. In addition, the presentation of only apriority probabilities have significant practical importance, since it would permit searching for approximate solutions of complex combinatorial problems, considering the limited capabilities of modern computers (without using brute force algorithm), and eliminates the necessity of creation of large and complex vocabularies that require significant efforts.

As it is seen from Figure 8.1 the problem is similar to those solved in chapter 6.5. If we represent conditional probability deviation of text fragments' appearance from an absolute probability, as the result of influence of various grammar rules and author thoughts on this text, then the problem can be solved using methods described in Part 6.

But first let us talk about one assumption. With a large number of different fragments, in the general case, the probability of text fragment's appearance is much smaller than the probability of its nonappearance (a lot of letters). Then:

$$p(A^{-i}) < \; p(\overline{A}^{-i}) \Rightarrow p(A^0) \approx p(A^0 / \overline{A}^{-i}),$$

where $p(A^{-i})$ – the probability of that the next text fragment is A^{-i};

$p(\overline{A}^{-i})$ – the probability that the next text fragment is not A^{-i};

$p(A^0)$ – the probability that the next text fragment is A^0;

$p(A^0 / \overline{A}^{-i})$ – the conditional probability of appearance of text fragment A^0, if previous fragment is not A^{-i}.

Then, it is appropriate to use the absolute probability of the text fragments' appearance as initial probability in introformational methods 1 and 2.

Let us consider an example.

Example 8.1. Let:

$$\begin{aligned} p_0 &= p(A^0) = 0{,}02; \\ p_1 &= p(A^0 / A^{-1}) = 0{,}05; \\ p_2 &= p(A^0 / A^{-2}) = 0{,}01; \\ p_3 &= p(A^0 / A^{-3}) = 0{,}035. \end{aligned} \qquad (8.2)$$

Let us tabulate the solution of this example in Table 8.1. This solution is obtained by the introformational methods 1 and 2 provided in Part 6.

The resulting joint conditional probability exceeds the unconditional one in more than two times:

$$p(A^0 / A^{-1}A^{-2}A^{-3}) = 0{,}044\ (0{,}046) > p(A^0) = 0{,}02.$$

Table 8.1

Tabular representation of example 8.1 solution by introformational methods

№	Operation	Transformation		Result		
		Method 1	Method 2		Method 1	Method 2
0	Source data	$D_0 - manifestation$ $b_j, j = \overline{1,n} - conditions$ $p_0 = p(D_0)$ $p_j = p(D_0 / b_j)\ \ j = \overline{1,n}$		p_0	0,020	
				p_1	0,050	
				p_2	0,010	
				p_3	0,035	
				p_4	-	
1	Certainty calculation	$d_j = \frac{\mathrm{sgn}(p_j - \frac{1}{2})}{2} \cdot \sqrt{\frac{p_j}{1-p_j} + \frac{1-p_j}{p_j} - 2},\ j = \overline{0,n}$		d_0	-3,429	
				d_1	-2,065	
				d_2	-4,925	
				d_3	-2,530	
				d_4	-	
2	Awareness calculation	$i_j = \sqrt{d_j^2 + 1},\ j = \overline{0,n}$		i_0	3,571	
				i_1	2,294	
				i_2	5,025	
				i_3	2,721	
				i_4	-	
3	Total certainty increment	$\Delta d = i_0 \sum_{j=1}^{n} d_j - d_0 \sum_{j=1}^{n} i_j$	$\delta_j = d_j i_0 - d_0 i_j$	δ_1	-	0,492
				$d2$	-	-0,359
				δ_3	-	0,291
				$d4$	-	-
			$\alpha = \sum_{j=1}^{n} \left[\frac{\mathrm{sgn}(\delta_j) \cdot \delta_j^2}{\sqrt{\delta_j^2 + 1}} \right]$	α	-	0,177
			$\Delta d = \mathrm{sgn}(\alpha) \sqrt{\frac{\alpha^2}{2} + \sqrt{\frac{\alpha^4}{4} + \alpha^2}}$	$\Delta\delta$	0,424	0,440
4	Awareness increment	$\Delta i = \sqrt{\Delta d^2 + 1}$		Di	1,086	1,093
5	New certainty	$d_\Sigma = \Delta d \cdot i_0 + d_0 \cdot \Delta i$		dS	-2,209	-2,174
6	New awareness	$i_\Sigma = \sqrt{d_\Sigma^2 + 1}$		$i\Sigma$	2,425	2,393
7	New probability	$p_\Sigma = 0{,}5 + \frac{d_\Sigma}{2i_\Sigma}$		$p\Sigma$	0,044	0,046

Probably, there are some people who want to argue with me that the actual joint conditional probability is different, not equal to the one calculated using the proposed method, in case with these partial conditional and absolute probabilities. It is useless to argue. I agree that it can be different with a significant probability. After all, physicists know that at the level of micro-particles the law of conservation of energy is violated at small time intervals, but for many objects and for a long time interval the law is observed. Here we have similar situation. The author suggests that proposed joint conditional probability which is obtained using one of the methods is the average (expected probability). In addition, it is important for prediction to get not the probability, but that fragment, the probability of which is the highest. That is, the solution is based on the decisive rule (8.1). No need to calculate the joint conditional probability accurately. The calculation of all the collective conditional probabilities within a single method is identical.

Using the introformational methods, the author has carried out a series of computer experiments on natural-language texts. These results are included in my monographs [12, 31] and presented further.

8.2. The Results of Experiments

Experiment 1. Table 8.3 shows the results of prediction of various texts fragments, obtained by the methods described in Table 8.2. The results clearly demonstrate the advantage of the method 11 (table 8.2), based on the use of introformational model. Usage of this method gives better results (comparing to other methods) in prediction of the development of natural language texts.

Experiment 2. The most important test was to check for compliance of introformational dependences with statistical regularities in natural language texts. This verification was carried out by using the distorted expressions (5.7) for predicting next text fragments

$$d = \pm 0{,}5 \cdot \sqrt{\frac{p}{1-p} + \frac{1-p}{p} - 2} \Rightarrow d = \pm c\sqrt{\left(\frac{1}{2\sqrt{p(1-p)}}\right)^{y} - 1}. \qquad (8.3)$$

Table 8.2

Methods of prediction of the natural language texts development

№	Method	Formalization ($j = \overline{1,n}$)
	Probabilistic approach	
1.	By previous fragment	$\max_j\left(p(A_j^0 / A^{-1})\right)$
2.	By fragment before the previous one	$\max_j\left(p(A_j^0 / A^{-2})\right)$
3.	By fragment that specifies maximal probability	$\max_j\left(\max\left(p(A_j^0 / A^{-1})\ p(A_j^0 / A^{-2})\right)\right)$
4.	By arithmetic mean value of conditional probabilities	$\max_j\left(\frac{p(A_j^0 / A^{-1}) + p(A_j^0 / A^{-2})}{2}\right)$
5.	By geometric mean value of conditional probabilities	$\max_j\left(\sqrt{p(A_j^0 / A^{-1}) \cdot p(A_j^0 / A^{-2})}\right)$
6.	By Dp	$\max_j\left(\frac{\frac{p(A_j^0)}{1-p(A_j^0)} \cdot \frac{p(A_j^0 / A^{-1})}{p(A_j^0)} \cdot \frac{p(A_j^0 / A^{-2})}{p(A_j^0)})}{1+\frac{p(A_j^0)}{1-p(A_j^0)} \cdot \frac{p(A_j^0 / A^{-1})}{p(A_j^0)} \cdot \frac{p(A_j^0 / A^{-2})}{p(A_j^0)}}\right)$
	Combined approach	
7.	By maximal certainty	$\max_j\left(\max\left(d(A_j^0 / A^{-1})\ d(A_j^0 / A^{-2})\right)\right)$
8.	By arithmetic mean value of certainty	$\max_j\left(\frac{d(A_j^0 / A^{-1}) + d(A_j^0 / A^{-2})}{2}\right)$
9.	By geometric mean value of certainty	$\max_j\left(\sqrt{d(A_j^0 / A^{-1}) \cdot d(A_j^0 / A^{-2})}\right)$
	Informational approach	
10.	On the basis of classical information theory	$\max_j\big(-p(A_j^0 / A^{-1})\log_2 p(A_j^0 / A^{-1}) - (1-p(A_j^0 / A^{-1})) \cdot \log_2(1-p(A_j^0 / A^{-1})) + p(A_j^0)\log_2 p(A_j^0) + (1-p(A_j^0)) \cdot \log_2(1-p(A_j^0)) - p(A_j^0 / A^{-2})\log_2 p(A_j^0 / A^{-2}) - (1-p(A_j^0 / A^{-2})) \cdot \log_2(1-p(A_j^0 / A^{-2})) + p(A_j^0) \cdot \log_2 p(A_j^0) + (1-p(A_j^0)) \cdot \log_2(1-p(A_j^0))\big)$
	Introformational approach	
11.	Introformational method 1	see section 6

The experiments showed that at distortion of the formulae the probability of correct text fragments prediction became worse. This means that introformational dependences form at least a local extremum in obtaining the joint conditional probability by a partial one.

Table 8.4 shows the values of expression (8.3), obtained by computer simulations using introformational method 1. In experiments, in the expression (8.3) two out of three arguments (c, z and y) were recorded in turns. Using these values, the graphs were built (Fig.8.2).

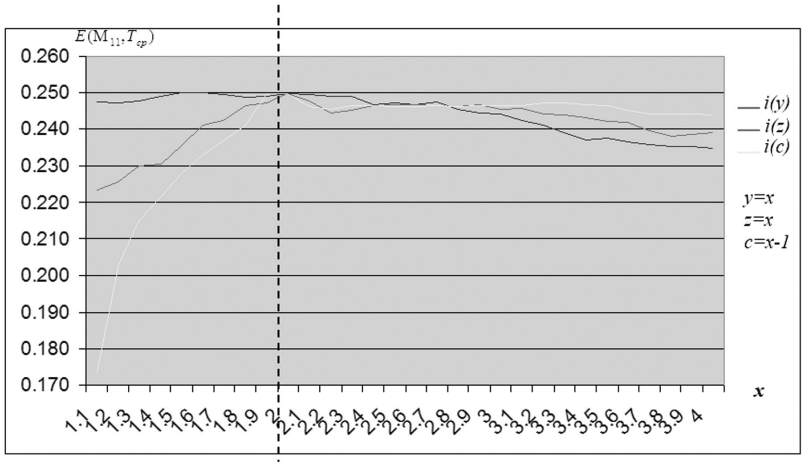


Figure 8.2. The effectiveness of text fragment prediction using expression (8.3)

As you can see from the graphs and tables, in the result of experimental studies the assumption was confirmed that the highest probability of correct prediction of the next texts fragment is close to the values $z = 2$; $y = 2$; $c = 1$.

This result defines the **possibility** of creation of the artificial intelligence systems using introformational methods.

Table 8.3

Prediction results of text fragment's appearance

№ Method	Method	Text						
		Popular wisdom	Dissertation	Fantasy	Document 1	Document 2	Document 3	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1.	By previous fragment	30919	17442	151109	8461	18407	10134	236472
		0,159	*0,070*	*0,165*	*0,214*	*0,193*	*0,179*	*0,152*
2.	By fragment before the previous one	36289	14504	173788	9557	19834	11602	265574
		0,187	*0,058*	*0,189*	*0,242*	*0,208*	*0,205*	*0,171*
3.	By fragment that specifies maximal probability	36300	18750	168919	10165	22653	12035	268822
		0,187	*0,075*	*0,184*	*0,257*	*0,238*	*0,212*	*0,173*
4.	By arithmetic mean value of conditional probabilities	41998	21932	199106	11753	2457	14255	313620
		0,216	*0,088*	*0,217*	*0,298*	*0,026*	*0,251*	*0,202*
5.	By geometric mean value of conditional probabilities	44781	23052	208978	12347	28672	16465	334295
		0,230	0,092	0,228	0,313	0,301	0,290	0,215
6.	By D*p*	44458	23355	202281	12059	27991	16347	326491
		0,229	*0,093*	*0,220*	*0,305*	0,294	0,288	0,210
7.	By maximal certainty	36423	18352	169344	9991	22226	13575	269911
		0,187	*0,073*	*0,184*	*0,253*	*0,234*	*0,239*	*0,174*
8.	By arithmetic mean value of certainty	44135	22735	210711	12029	29516	17633	336759
		0,227	0,091	0,230	0,305	0,310	0,311	0,217
9.	By geometric mean value of certainty	43937	22453	210956	12397	29750	17249	336742
		0,226	*0,090*	*0,230*	*0,314*	0,313	0,304	0,217
10.	Based on classical information theory	46567	23041	219601	12872	29179	17848	349108
		0,239	*0,092*	*0,239*	*0,326*	*0,307*	*0,315*	*0,225*
11.	Based on introformational method 1 (see section 6.3)	48226	22982	230984	12815	29943	17985	362935
		0,248	*0,092*	*0,252*	*0,324*	*0,315*	*0,317*	*0,234*

Note. The upper line is the number of correctly "predicted" fragments. Bottom line (in italics) is the ratio of correctly predicted fragments to the total number of fragments.

Experiment 3. Synergistic effect from the joint action of two or more previous text fragments leads to the fact that the estimated and actual joint conditional probabilities in general case do not match.

Table 8.4

The probabilities of correct prediction in a small neighbourhood of the expression (8.3)

x	The probability of text fragment correct prediction for functions								
	$i=\sqrt[x]{\left(\frac{1}{2\cdot\sqrt{p\cdot(1-p)}}\right)^{x}}-1$			$i=\sqrt[x]{\left(\frac{1}{2\cdot\sqrt{p\cdot(1-p)}}\right)^{2}}-1$			$i=(x-1)\cdot\sqrt{\left(\frac{1}{2\cdot\sqrt{p\cdot(1-p)}}\right)^{2}}-1$		
	All texts (Tср)	**Science fiction (Тфан)**	**Proverbs (Тпос)**	**All texts (Tср)**	**Science fiction (Тфан)**	**Proverbs (Тпос)**	**All texts (Tср)**	**Science fiction (Тфан)**	**Proverbs (Тпос)**
1	0,247	0,249	0,245	0,221	0,216	0,225	–	–	–
1,1	0,247	0,249	0,246	0,223	0,217	0,229	0,174	0,171	0,177
1,2	0,247	0,249	0,246	0,226	0,221	0,230	0,203	0,200	0,205
1,3	0,248	0,249	0,247	0,230	0,226	0,234	0,215	0,213	0,217
1,4	0,249	0,251	0,247	0,231	0,227	0,234	0,222	0,220	0,224
1,5	0,250	0,253	0,247	0,236	0,233	0,239	0,228	0,230	0,226
1,6	0,250	0,254	0,247	0,241	0,237	0,245	0,233	0,237	0,228
1,7	0,250	0,253	0,246	0,243	0,237	0,248	0,237	0,233	0,241
1,8	0,249	0,252	0,246	0,247	0,247	0,246	0,241	0,242	0,240
1,9	0,249	0,252	0,247	0,247	0,250	0,244	0,250	0,250	0,249
2,0	0,250	0,252	0,248	0,250	0,252	0,248	0,250	0,252	0,248
2,1	0,249	0,252	0,247	0,248	0,251	0,245	0,246	0,249	0,243
2,2	0,249	0,251	0,247	0,245	0,246	0,243	0,246	0,248	0,243
2,3	0,249	0,251	0,247	0,245	0,247	0,243	0,246	0,249	0,243
2,4	0,247	0,249	0,245	0,246	0,249	0,244	0,246	0,249	0,243
2,5	0,247	0,249	0,245	0,247	0,249	0,244	0,246	0,250	0,242
2,6	0,247	0,248	0,246	0,247	0,249	0,245	0,246	0,251	0,241
2,7	0,247	0,248	0,247	0,246	0,248	0,244	0,246	0,252	0,241
2,8	0,245	0,244	0,247	0,246	0,248	0,244	0,246	0,252	0,241

Table 8.4 (continuation)

1	2	3	4	5	6	7	**8**	**9**	**10**
2,9	0,244	0,242	0,246	0,247	0,250	0,243	0,247	0,252	0,241
3,0	0,244	0,242	0,246	0,245	0,247	0,244	0,246	0,252	0,241
3,1	0,242	0,243	0,242	0,246	0,249	0,243	0,246	0,251	0,241
3,2	0,241	0,240	0,242	0,244	0,249	0,240	0,247	0,251	0,243
3,3	0,239	0,237	0,241	0,244	0,248	0,240	0,247	0,251	0,243
3,4	0,237	0,237	0,237	0,243	0,247	0,239	0,247	0,251	0,243
3,5	0,238	0,238	0,237	0,242	0,247	0,237	0,247	0,251	0,242
3,6	0,237	0,237	0,236	0,242	0,247	0,237	0,245	0,249	0,242
3,7	0,236	0,237	0,235	0,240	0,246	0,233	0,244	0,247	0,242
3,8	0,235	0,235	0,235	0,238	0,244	0,232	0,244	0,247	0,242
3,9	0,235	0,235	0,235	0,239	0,244	0,233	0,244	0,247	0,242
4,0	0,235	0,235	0,235	0,239	0,244	0,234	0,244	0,247	0,241

Note. Bold text denotes the maximum values. Italics and underlining denote values obtained from the theoretical model.

$$p_{prg}(A_k^0 / A^{-1}...A^{-m}) \neq p_{act}(A_k^0 / A^{-1}...A^{-m}),$$

where $p_{prg}(A_k^0 / A^{-1}...A^{-m})$ – the estimated joint conditional probability of the appearance of text fragment A_j^0, if the previous fragments in text are $A^{-1},\ldots,A^{-m}$;

$p_{act}(A_k^0 / A^{-1}...A^{-m})$ - the actual joint conditional probability of the appearance of text fragment A_j^0, if the previous fragments in text are $A^{-1},\ldots,A^{-m}$.

This effect is present in all areas of human intellectual activity and it must also be calculated and considered. But how can it be done? In the work [12], this issue has not been studied. But the issue, associated with the calculation of certainty that corresponds to the difference between actual and estimated probability $\Delta d(A_k^0 / A^{-1}...A^{-m})$, has been studied.

Value of $\Delta d(A_k^0 / A^{-1}...A^{-m})$ defines the additional certainty that is necessary for reducing of theoretically obtained value of joint conditional probability to the actual value. In computer simulations, graphs of the value $\Delta d(A_k^0 / A^{-1}...A^{-m})$ distribution were obtained (Fig.8.3).

Experiment 4. Experiments with the text of the monograph [31] (Parts from 1 to 4). In these texts, the fragments with length from 1 to 5 letters are marked.

The appearance of the next text fragment was predicted by 2-3 previous fragments (table.8.5-8.7). On the basis of the text fragments consecution, statistical information was formed. The probability was determined by frequency of appearance of some fragments after others. More precisely, as the probability of fragments' appearance their frequency was used. For the purity of the experiment, from the total set of fragments, sequences $A^{-m}...A^{-1}A^0$ were excluded.

1. Single option. When, one and the same fragment followed after the given set of previous fragments, that is

$$p_{act}(A_k^0 / A^{-1}...A^{-m}) = 1.$$

2. Equiprobable when the maximum probability of the appearance of text fragments using the preceding ones, is true for different fragments

$$\forall A_k^0 \in A^0\ \exists A_i^0 \in A^0, A_j^0 \in A^0 : p_{act}(A_i^0 / A^{-1}...A^{-m}) = p_{act}(A_i^0 / A^{-1}...A^{-m}),$$

and

$$\forall k \neq i, k \neq j\ p_{act}(A_i^0 / A^{-1}...A^{-m}) > p_{act}(A_k^0 / A^{-1}...A^{-m}).$$

3. Definitely determined prognosis for all the previous fragments; when the probability of some fragment appearance after each of all the preceding fragments is equal to 1.

$$\forall A^{-i}, i = \overline{1,m}\ \exists A_k^0 \in A^0 : p_{act}(A_k^0 / A^{-i}) = 1.$$

This rule is only used for the experiments; the results are presented in table.8.6.

4. Definitely determined prognosis for some of the previous fragments; when after one of the previous fragments, the probability of the next text fragment appearance is equal to 1

$$\exists A^{-i}, 1 \le i \le m\ \exists A_k^0 \in A^0 : p_{act}(A_k^0 / A^{-i}) = 1.$$

This rule is only used for the experiments; the results are presented in table.8.7.

The experimental results are presented in Tables 8.5-8.7.

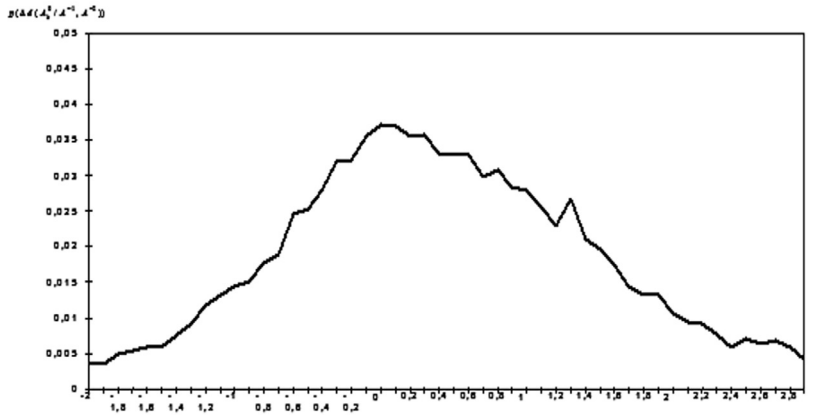


Fig.8.3. Graph of the actions distribution by the essence of compatibility of text fragments.

Table 8.5

Prediction of text fragments' appearance in sections 1-4

Fragments lengths	% of correct predicted fragments							Quantity of correct predicted fragments					
	Random (*Rnd*)	Method 1	Method 2	By $p(A_k^0/A^{-1})$	By $p(A_k^0/A^{-2})$	By $p(A_k^0/A^{-3})$	By $p(A_k^0)$	Method 1	Method 2	By $p(A_k^0/A^{-1})$	By $p(A_k^0/A^{-2})$	By $p(A_k^0/A^{-3})$	By $p(A_k^0/A^{-1}A^{-2}A^{-3})$
By two previous fragments													
1	28,83	58,69	58,69	54,68	54,68	0,00	45,17	31084	30896	26374	25897	0	43638
2	54,58	86,62	85,93	81,09	86,96	0,00	65,59	16984	16872	15889	16855	0	18130
3	72,74	97,90	97,96	96,01	99,15	0,00	85,96	7068	7072	6951	7124	0	7158
4	77,91	99,53	99,53	98,66	99,71	0,00	92,25	2934	2934	2906	2942	0	2948
5	85,80	99,69	99,69	99,08	99,80	0,00	97,24	1444	1444	1436	1446	0	1448
By three previous fragments													
1	31,89	58,78	58,67	56,65	56,15	52,99	50,36	36685	35508	31292	32442	29948	49830
2	66,60	92,67	92,22	87,29	91,09	92,72	77,53	11170	11139	10462	10988	11164	11651
3	77,91	98,90	99,01	96,36	98,79	99,28	89,09	3247	3250	3172	3246	3258	3272
4	81,73	99,38	99,51	99,26	99,26	99,88	96,17	1303	1314	1303	1302	1318	1320
5	89,01	99,72	99,72	99,15	99,72	100,00	98,87	478	478	475	478	479	479
Total								**112397**	**110907**	**100260**	**102720**	**46167**	**139874**
%								**80**	**79**	**72**	**73**	**69**	**100**

Table 8.6

Prediction of text fragments' appearance in sections 1-4 (combinations of fragments that do not have alternative choice in all previous fragments are excluded)

Fragments lengths	% of correct predicted fragments							Quantity of correct predicted fragments					
	Random (*Rnd*)	Method 1	Method 2	By $p(A_k^0/A^{-1})$	By $p(A_k^0/A^{-2})$	By $p(A_k^0/A^{-3})$	By $p(A_k^0)$	Method 1	Method 2	By $p(A_k^0/A^{-1})$	By $p(A_k^0/A^{-2})$	By $p(A_k^0/A^{-3})$	By $p(A_k^0/A^{-1}A^{-2}A^{-3})$
By two previous fragments													
1	31,55	58,83	58,68	54,26	54,57	0,00	44,95	29889	29485	24849	24915	0	41205
2	57,81	87,70	87,08	81,57	89,12	0,00	69,65	7869	7831	7352	7901	0	8407
3	66,83	97,41	97,41	95,15	99,84	0,00	89,32	1387	1387	1367	1404	0	1405
4	55,04	98,45	98,45	96,90	98,45	0,00	93,02	343	343	341	346	0	349
5	63,41	97,56	97,56	92,68	95,12	0,00	85,37	69	69	67	68	0	70
By three previous fragments													
1	30,40	58,65	58,61	56,61	56,19	52,96	50,35	36519	35345	31150	32300	29890	49638
2	66,43	94,32	93,76	88,83	92,68	94,57	79,65	7979	7960	7473	7843	7990	8252
3	71,98	98,41	98,63	94,99	98,41	100,00	91,80	884	886	858	885	892	892
4	60,82	97,94	97,94	97,94	97,94	98,97	95,88	311	311	312	311	312	314
5	72,73	100,00	100,00	100,00	100,00	100,00	100,00	30	30	30	30	30	30
Total								85280	83647	73799	76003	39114	110562
%								77	76	67	69	66	100

Table 8.7

Prediction of text fragments' appearance in sections 1-4 (combinations of fragments that do not have alternative choice in at least one previous fragment are excluded)

Fragments lengths	% of correctly predicted fragments						Quantity of correctly predicted fragments					
	Random (*Rnd*)	Method 1	Method 2	By $p(A_k^0/A^{-1})$	By $p(A_k^0/A^{-2})$	By $p(A_k^0/A^{-3})$	By $p(A_k^0)$	Method 1	Method 2	By $p(A_k^0/A^{-1})$	By $p(A_k^0/A^{-2})$	By $p(A_k^0/A^{-3})$	By $p(A_k^0/A^{-1}A^{-2}A^{-3})$
By two previous fragments													
1	33,05	62,11	61,54	57,26	57,26	0,00	48,72	14652	14505	12246	12651	0	19874
2	55,66	90,29	90,94	87,38	87,06	0,00	72,82	884	885	860	852	0	929
3	75,00	100,00	100,00	100,00	100,00	0,00	75,00	55	55	55	55	0	55
4	33,33	100,00	100,00	100,00	100,00	0,00	100,00	64	64	64	64	0	64
By three previous fragments													
1	29,94	58,13	57,79	56,13	56,23	52,23	50,05	29985	28853	24610	26602	24259	40395
2	68,11	95,90	95,67	92,26	92,26	94,76	80,64	922	921	896	891	920	947
3	30,00	100,00	100,00	100,00	100,00	100,00	100,00	94	94	94	94	94	94
4	25,00	100,00	100,00	100,00	100,00	100,00	100,00	62	62	62	62	62	62
Total								46718	45439	38887	41271	25335	62420
%								75	73	62	66	61	100
Total table. 8.5-8.7								244395	239993	212946	219994	110616	312856
%								78	77	68	70	66	100

Tables 8.5-8.7 present obtained percentage of the text fragments correct predictions:

Random (RND) – a random selection of the next fragment (uniform distribution).

Method 1 – prognosis by introformational method 1.

Method 2 – prognosis by introformational method 2.

By conditional probability specified by the fragment which precedes the fragment that is being predicted ($p(A_k^0/A^{-1})$).

By conditional probability specified by the fragment which is one fragment before the fragment that is being predicted ($p(A_k^0/A^{-2})$).

By conditional probability specified by the fragment which is two fragments before the fragment that is predicted ($p(A_k^0/A^{-3})$).

By the absolute probability of the predicted fragment's appearance ($p(A_k^0)$).

What follows from the experiments? As it can be seen from tables 8.5-8.7, introformational method 1 is the most effective for prediction. This method is almost always the best even with a small statistical sample, which is based on the text of Parts 1-4 [31]. The only thing that is necessary to note is that if the share of not excluded combinations (that definitely determine the text development) is significant, than the prediction by separate fragments gives a slightly better result. If the fragments' combinations (that definitely determine the text development) are excluded, than introformational methods are better.

By the example of prediction of the texts development, it is shown that:

1. Prognosis method that is based on introformational Method 1 is more effective than others.

2. Prediction results in the small neighbourhood of the expression (5.7) (formula 8.3) worsen. This confirms the theory and suggests the applicability of introformational methods for solving many problems of forecasting and decision-making under the incomplete information situation.

3. Mathematical expectation of the law of additional impact probability distribution by the essence of simultaneous occurrence of fragments of texts is almost equal to 0. This allows creating effective systems for forecasting even without consideration (especially at the initial stage of creation of the knowledge base for such systems) of the interactions values $\Delta d(A_k^0 / A^{-1}...A^{-m})$.

The prediction results of the texts' development demonstrate the adequacy of the obtained functional expression to the laws of the natural language texts' construction [12]. This makes it possible to use the developed introformational methods as a mathematical base for constructing artificial intelligence systems.

Efficiency of application of the methods elaborated within the stated approach for solving prediction problems of the development of natural language text indicates the firmness of the used scientific and methodological base. Therefore, it indicates the possibilities of its application for solving problems related to organization of information processing in intelligent systems (for various purposes).

The next Part of this work is devoted to this issue.

PART 9
REFLEX INTELLIGENCE SYSTEMS

If we are talking about universality of laws of existence and operation of information systems in Nature at any level of matter's motion, and even revealing the mystery of these laws, the question immediately arises, why does Nature allow us to do this? More precisely, why Nature is constructed in such a way that makes it possible to know not only the laws of matter motion, but also the laws which lie in the basis of the laws of motion in our Universe? These questions are too global to give an exhaustive answer in this monograph. This question has been investigated in many works of philosophers on the theory of knowledge. However, this question is formulated differently, as the possibility of cognizing the laws of Nature that are more general than the physical, its Meta-Laws. If Nature allows us to do this, then it wants us to do this! Maybe we are to create artificial systems at the technical level of the matter motion, on the basis of disclosed laws of existence and operation of information systems in Nature. For example, natural-language communication systems, robots, expert systems. Maybe we are to create artificial intelligence which is equal to human's one? Maybe, in the distant future, our own artificial Universe?!

I think that it is not some fiction now! If we acknowledge the informational basis of Nature through the confirmation of it in other studies, through accepting it by the scientists in various fields of natural sciences, then it will create a foundation for transition into technical and informational future of humanity.

Currently, this concept is seen as global and forward-looking. But in this work we talk about creating simple reflex intelligence systems in

some areas of human activity, as an example of the use of introformational approach at the technical level of matter motion.

Definition 9.1. Introformational approach to the creation of artificial intelligence systems is the approach in which the creation of such systems is carried out using introformational methods.

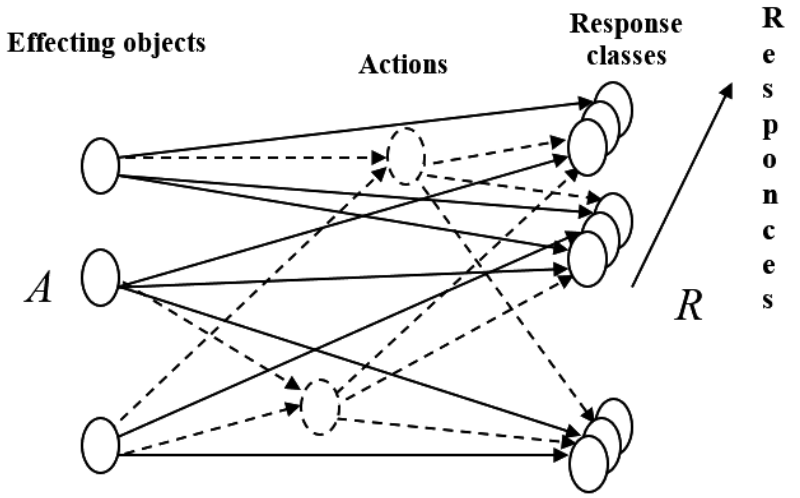
Intelligent systems developed by the introformational approach, are called responsive, since, by analogy with the higher nervous activity of living beings, they are able to generate responses to various combinations of input actions. In biology, a reflex is a response to stimulation of the body, carried out by the nervous system. Under the reflex of intelligent system we mean a response to the input influences that are produced by an algorithm that we call reflex.

Definition 9.2. Reflex intelligence systems are software or technical systems that form reactions to non-forceful actions on the basis of introformational methods. In this case, the adequacy of the reaction is ensured by correspondence of these methods to the laws of Nature in introformational interpretation.

9.1. The Concept of the construction of reflex intelligent systems

Introformational model is the basis of creation of the reflex intelligent software systems which solve the problems: natural language access to databases, valuation of investment proposals, prediction of water pollutants effect on public health, prediction of sports games outcomes. Algorithmic basis of such systems is given in Part 6; calculation methods of the appropriate reaction to a set of different, poorly structured input actions.

The principles of universal modelling of the regularities in a given subject area are implemented (in the sense of universality of the introformational organisation of matter) within the concept of creation of the reflex intelligent systems. It allows setting the goal-oriented step-by-step research of phenomena essence in terms of causality and regularity that do not require empirical verification. The basis of the reflex intelligent systems operation is a reflex algorithm that is based on the developed introformational methods. The algorithm ensures the most probable selection of intelligent system's reaction on the set of input actions, under known probabilities of reaction's selection for each input action, as well as for some combinations of input actions. The problem is similar to the one that is implemented by the classical perceptrons. But unlike perceptrons, the reflex algorithm directly calculates the adequate reaction to the input influences of the intellectual system (Fig.9.1). Adequacy of response is based on the assumption that the laws of non-forceful interaction are the same at all levels of representation of interacting systems: no matter if they are animate or inanimate objects. The regularities of existence and development of intellectual human activity areas obey the same laws (the confirmation of this for natural language texts was obtained in the previous section).



Note: virtual objects that reflect the compatibility of action (synergetic effect) are marked with dotted lines

Fig.9.1. The scheme of calculation of the action's magnitude in the reflex intelligent systems

The algorithm for calculating the adequate response of intellectual system consists of the next steps:

1. The calculation of certain response of intellectual system relative to influence. Physical analogy of certainty is the material objects momentum. In this model, we consider two groups of objects – acting through the "collision" and the transfer of one's own certainty (momentum) to objects, which are under influence (corresponding to the possible responses). From (5.7) and (5.6):

$$d(R_i) = \pm 0{,}5\sqrt{\frac{p(R_i)}{1-p(R_i)} + \frac{1-p(R_i)}{p(R_i)} - 2};$$

$$i(R_i) = \sqrt{d^2(R_i)+1};$$

$$d(R_i / A_j) = \pm 0{,}5\sqrt{\frac{p(R_i / A_j)}{1-p(R_i / A_j)} + \frac{1-p(R_i / A_j)}{p(R_i / A_j)} - 2};$$

$$i(R_i / A_j) = \sqrt{d^2(R_i / A_j)+1},$$

where $p(R_i)$ – unconditional probability of selection of response R_i;

$d(R_i)$ – certainty of intellectual system with respect to reaction R_i;

$i(R_i)$ – awareness of intellectual system with respect to reaction R_i;

$p(R_i/A_j)$ – conditional probability of the selection of response R_i under action A_j;

$d(R_i/A_j)$ – certainty of intellectual system with respect to reaction R_i after action A_j;

$i(R_i/A_j)$ – awareness of intellectual system with respect to reaction R_i after action A_j.

2. Using the expression (5.13), we calculate the additional certainty that is introduced into intellectual system by acting objects:

$$\Delta d(R_i / A_j) = d(R_i / A_j) \cdot i(R_i) - d(R_i) \cdot i(R_i / A_j)$$

where $Dd(R_i/A_j)$ – certainty change of intellectual system's reaction R_i under action A_j.

3. Total effect on the intellectual system's reaction is calculated from introformational representation of the law of conservation of momentum (5.16). Similar to "stroke" of a set of moving objects (that correspond to the impacts) at other objects (that correspond to reactions):

$$\Delta d_\Sigma(R_i) = \sum_j \Delta d(R_i / A_j),$$

where $Dd_S(R_i)$ – certainty change of intellectual system's reaction R_i. From (5.6):

$$\Delta i_\Sigma(R_i) = \sqrt{\Delta d_\Sigma^2(R_i)+1}.$$

4. New certainty of intellectual system is calculated (similar to the new speed of motion after momentum received during the collision with influencing objects) (5.14):

$$\overline{d(R_i)} = \Delta d_\Sigma(R_i) \cdot i(R_i) + d(R_i) \cdot \Delta i_\Sigma(R_i),$$

where $\overline{d(R_i)}$ – new certainty of intellectual system's attitude to reaction R_i.

5. Selection of reaction R_k with maximum certainty:

$$R_k : R_k \in R \wedge \overline{d(R_k)} = \max_i(\overline{d(R_i)}).$$

Creating reflex intelligent systems using this algorithm, we must solve two main problems: select from subject area and formalize the influencing objects and the responses with accumulation of statistical information on the connections between them; adapt the reflex algorithm to the features of the subject area. Let us examine these tasks in the developed reflex intelligent systems.

9.2. The natural-language text compiler (NTC)

The effectiveness of information technologies depends largely on the language communicative means (with computer). The known domestic and foreign systems of natural-language media processing are experimental or narrowly focused and do not satisfy the requirements of information technology. In addition, the costs of creating such systems are considerable. That is why they cannot be widely used [5, 26-27].

Nevertheless, performance of computer-based system (when filling the knowledge base) without such tools is greatly reduced. There-

fore, the costs increase (additional encoding, search in the knowledge base, etc.).

Adaptability and flexibility of "computer" communication languages, non-procedural nature of the objects and processes descriptions, usage of "context" and "default" are preconditions of rational construction of language means. These requirements are contradictory; due to focus on non-professional users on the one hand, and the limited abilities (both theoretical and technical) on the other. Solution to this problem can be connected to reflex natural-language texts processing algorithm. Its usage is explained by the fact that:

– it is not necessary to perform morphological and semantic analysis of text that reduces the costs of natural-language communication systems development;

– the fragmentary structure of the system thesaurus increases its stability and allows processing of different texts;

– easy implementation;

– high reliability of recognition of the semantic text component;

– adaptability to different input texts.

The creation of natural-language text compiler (NTC) is based on usage of the methods stated in Part 6 for identification of algorithm and basic parameters of a query on combinations of incoming natural language text fragments. The compiler is based on the mathematical model of non-forceful interaction in objects and processes that form natural-language texts. The compiler provides the formation of the resulting, formal representation of the semantic component of the input text under its representation by natural-language means.

Morphological structure of the compiler is generated by a set of NTC interactive information objects. The NTC information objects are: input text fragments – *S*; compiler reaction – *L*. Specific forms of reactions *L* are determined in the learning process, i.e. the process of the filling of vocabulary system *S* and linkage definition system *U*; such reactions are presented as output text, programs, requests to the database.

When processing input information in NTC, the means of natural-language communication are used for:

1. Access algorithm determination.

2. Object determination.

3. Output document time interval establishment.

4. Formal request submission with its implementation confirmation.

NTC implements a reflex model of behaviour in ambiguous interpreted environment of functioning. NTC is a specialized set of programs that provides an interface between the user, information base, the means of filling the knowledge base and data retrieval system.

Data flow diagram in the natural-language texts compiler is shown in Figure 9.2.

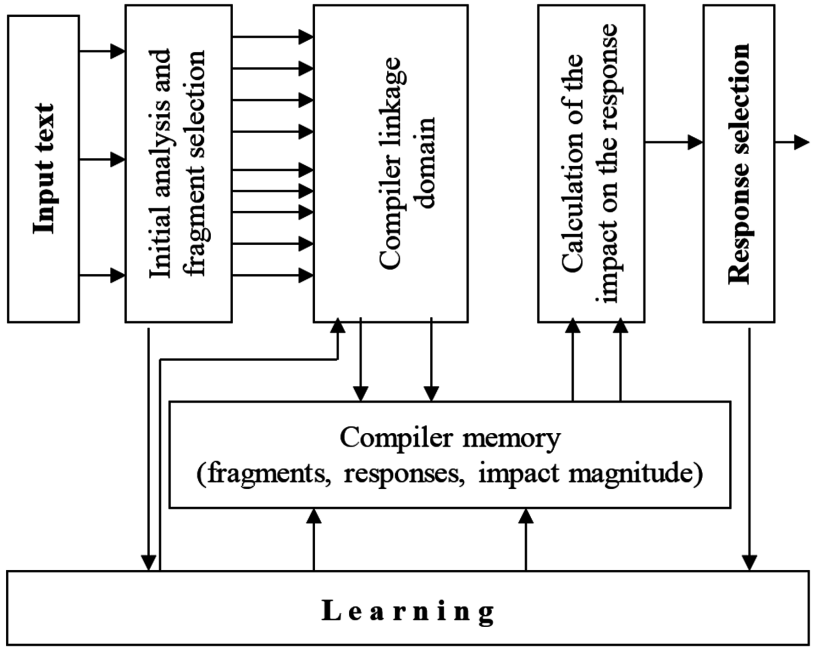


Fig.9.2. NTC data flow diagram

The natural-language text compiler includes next modules:

1. Initialization module; the initial states of the compiler tables are formed and established; system parameters of subject areas are recorded (creation date, user, and access level to the subject area).

2. System information base; consists of a thesaurus table, a compiler reflex table (output text), and linkage table of system information

objects. Thesaurus domain is a set of information objects that contain: input text fragments (influencing objects), links, and responses.

3. Training module; designed to fill the system knowledge base.

4. Text comprehension module; designed to handle the natural-language texts' input and to obtain a formal representation of semantic information that is contained in the text.

5. Access module; provides access to the compiler's core (CALL – interface); part of the NTC that allows to communicate and transmit the selected response to the user applications. The information to the user application is transmitted in the standard of natural-language text compiler. NTC standard is a strictly defined form of information transmission that is obtained during the processing of natural-language request.

6. Request module; implements a request (formalized in text comprehension module) to the database and creates an output document.

7. Subject area normalization module. Limited resources of modern computers create many problems in the implementation of procedures that require significant amount of memory and time constraints for their execution. To eliminate such deficiency, NTC estimates "utility" of acting objects and links; selects and deletes (from the memory) the least informative acting objects and links.

The natural-language text compiler was developed and used in the construction management of the South Ukrainian nuclear power plant [28]. Industrial exploitation of NTC allowed making a number of conclusions concerning the theoretical basis as well as the practical applicability of this development. These findings can be divided into three groups: correspondence between the results of system operation and theoretical model; practical effectiveness of the system; system costs.

1. Correspondence between the results of system operation and theoretical model. During the development and exploitation of natural-language communication system, a number of implementation options for non-forceful interactions procedures were tested. Efficiency and the observed "informational correctness of comprehension" of the essence of request by the computer indicate correspondence between the artificially created and the existing non-forceful interaction mechanism; consequently, they indicate significant probability that the assumptions made in the work are correct.

2. Practical effectiveness of the system. The main advantage of NTC is easy access to the information base. But this advantage has created one drawback. For example, it is uncomfortable for regular users to specify the full (or nearly full, even contractions were admitted) name of the object, executor, resource. Therefore, an indication of any element code of the system directories was provided.

3. System costs; consist of the software development costs (about 0.5 man-years); for system training – approximately 0.20 man-years. At this, a system of data objects has been organized that consists of: thesaurus – 4096 acting objects; links (influences) – 8128; system responses – 200. The costs of NTC are significantly lower than the cost of similar design. This can be explained by the greater efficiency of introformational approach, comparing to other approaches that are used in natural-language systems.

Note that the NTC is not about "comprehension" of limited natural language, but about a system that receives user queries in natural language without any limits. Implementing such system in a building firm, we even joked that it "sees and understands the language of builders" [28].

Overall, the results of experimental and industrial exploitation of the system showed its significant potential. This approach can be used in a wide range of artificial intelligence systems.

9.3. Forecast of influence of harmful substances in water resources on public health

(Prepared jointly with M. Oleksienko)

The results, obtained in the non-forceful interaction theory, were used to create an information system to evaluate and predict risks of population sickness from harmful impurities of water resources. To determine the numerical dependence between the effects of pollutants in water resources and the health of the population, a method that is based on the use of introformational model was developed [29]. Input information was the value of the harmful substances content in water and

sickness statistics. Source information was numerical measure of dependence between the listed objects categories and sickness rate in the region under the current water-ecological situation. Information system displayed the concentration of harmful substances in the region's water resources over the years and types of the disease. The content of harmful substances and sickness rate in the city of Cherkasy were examined.

The task of sickness rate forecast is formulated as follows:

By detected availability of harmful substances in water

$$X_s =< x_{1s}, x_{2s}, ..., x_{ks}, ..., x_{ms} >,$$

where X_s – tuple of values of harmful substances' content in the measurement s;

x_{ys} – the value of harmful substances content $v_y\hat{I}V$ in the measurement s;

m – the amount of harmful substances,

assess sickness risks for all diseases

$$Y_s =< y_{1s}, y_{2s}, ..., y_{rs}, ..., y_{ns} >,$$

where Y_s – tuple of forecasted disease risk (for the s-th dimension of harmful substances);

y_{rs} – the disease risk with the diagnosis $z_r\hat{I}Z$ (for the s-th dimension of harmful substances);

n – number of diseases types.

The risk of the disease means the probability of one or another disease. Assessments of the influence of harmful substances on the disease risk were carried out using method 1 described in Part 6. Solution of the problem is the overall assessment of population disease risk under the specified values of harmful substances in the water resources of the region.

The algorithms, software and information tools of information system of assessment and disease risk prediction were developed; they are based on introformational model of non-forceful interaction.

Next results were obtained: the effect of harmful substances on the sickness rate at first 1-8 years increases, but then the effect decreases.

This is observed for diseases of both children and adults. The results are described in more details in [31].

Exploitation of information system suggests the applicability of the developed models and methods of non-forceful interaction to describe the regularities of the processes in the environmental field.

9.4. The reflex expert system of investment proposals evaluation in development

(Prepared jointly with P. Kayuk and M. Chernova)

The peculiarity of development is the need to consider many factors. Different factors have different importance at various stages of project development, and some of them are "white noise", if used without considering the peculiarities of the project. Intelligent systems in this area cost a lot. Taking into account all features of the interdependence of factors increases the cost even more. Thus, to evaluate investment proposals, it becomes cheaper and easier to invite analysts, rather than create such systems. Therefore, the use of such systems in development is limited. A method of creation of the reflex intelligent systems which is based on the results obtained in the non-forceful interaction theory allows removing deficiencies and enhancing the benefits of such systems [30]. It was suggested to increase the probability of a correct assessment of investment proposals; to reduce the costs of such an assessment – through the development and implementation of the responsive expert system of investment proposals evaluation (REXS).

Statistics accumulated in the REXS is both positive and negative (correction to "white noise") which increases the accuracy of the result. In addition, there was the idea of calculating the possible solutions, not only on the basis of known information, but also of unknown parameters that have a long history in the knowledge base of intellectual system, embodied. Some of the parameters that describe the projects may not only have a certain number of values (numerical or periodical), but also be described simply by any text, since the algorithm can analyse any descrip-

tion and store this knowledge in the database. The system is called reflex, because in the process of filling the knowledge base, it creates responses on the different effects in the subject area. Under a new effects combination the most adequate response of the reflex system is chosen (response to the stimulation that describes situation in the development project). The system response can be in filling the missing lines of the document, which displays an analytical assessment of investment proposal.

System input information resource is a variety of copies of informational representations (documents and different descriptive information). Updating of informational representations is written as a frame that contains slots (the name of the parameter and its value) (table.9.1). In general, the frame-copy has some unfilled slots (in table.9.1 slots № *X* and *X+1*). REXS performs their filling. Information product of the system is all the slots filled in output copy of informational representation (each frame with slots that were empty in the beginning).

To solve this problem by using the principles and methods of the reflex intelligent systems' construction, an application was developed. It includes the execution of the following steps:

1. It sets the deviation of conditional probability values of each of the unfilled slots under the given values of the filled slots from the absolute probabilities of these values.

2. It interprets this deviation in terms of the non-forceful impact.

Table 9.1

Example of the investment proposal description in the REXS

№	Parameter	Value
1	Object type	Residential real estate
2	Plot of land characteristic	Rectangular
3	Land plot area	20 hectare
. . .	. . . . .	. . . . .
X	Estimated cost	?
X+1	Residential real estate segment	?
. . .	. . . . .	. . . . .
K	Initiator-company	Retro

1. It selects such values of unfilled slots that correspond to the maximum non-forceful impact (the most appropriate response to the impact). For this, the system implements the following functions:

3.1. Storage of tables that describe the implemented investment projects with a definite result.

3.2. On the basis of these tables, formation of the reaction values under the influence (statistics of dependence of values of some slots from others in all implemented projects).

3.3. Creation of the response to the new situation in the subject area (filling empty slots when a new investment proposal arrives).

Next modules are implemented in the system:

– training module on the basis of implemented investment projects (creation of knowledge base);

– empty slots filling module. The program works in both training and decision making modes. The special structure of the knowledge base was developed, which corresponds to the stated modes. The knowledge base is a set of tables that contains constant information (the result of system training);

– knowledge base;

– request module – information that displays problem statement by the user for expert evaluation of the business-proposal (the table with a partially unfilled slots);

– problem solution protocols module (the explanation of decisions).

Introformational model of non-forceful interaction in the intellectual human activity fields is the basis of the application. Algorithm that is based on this model simulates the reflex behaviour of a person – the existence of stereotyped reactions to external stimulation. Having the knowledge base statistics on successful and unsuccessful projects that are described by frame slots; it is possible to calculate the value of unfilled frame slots that display the unknown parameters of the new project. The values of slots are divided into:

1. Numeric; to increase the statistical sample of non-forceful action assessment, not the individual values, but ranges of values are given to system. A number is assigned to each interval. That number of values range is a parameter that affects the other parameters of the model. The quantity and intervals themselves are set by the expert.

2. Limited text set; it is a sample from a set of words or small sentences. Set may gradually increase.

3. Random text; an ordinary natural-language text of any length.

As a result of training, the value of non-forceful impact of pre-set parameters onto unfilled slots is calculated. The result of the system operation is an assessment of the joint conditional probability of unfilled slots values by the values of the filled slots. Mathematical dependences are applied to calculate such assessment of joint probability; dependences that reflect the non-forceful impact of objects and processes (that form the given parameters) on the unknown parameters of the investment proposals (Part 6). Such an approach is effective, because the parameters of development projects are defined by the owners, managers and professionals; i.e. formed by the human intellectual apparatus.

The system has a database diagnostic tool and input information check-up tool; error protection during entering and processing of information. System testing showed:

1. Due to the universal and simple non-forceful impact, the algorithm that is applied in the REXS generates the criteria for investment proposals evaluation.

2. The system provides wide abilities of knowledge base (storage of completed projects) and suggests possible solutions for future projects on the basis of accumulated knowledge.

3. The main advantage of the system is that the decisions are not based on summarized data, but on the "historical" data that are collected and organized by experts in the information standard of the company.

4. Experimental researches have shown almost complete (from 80% up to 100%) coincidence between the results of the REXS investment proposals evaluation and experienced experts' evaluation.

5. REXS can be used to support decision making in any area that can be described in terms of event or project (successful or unsuccessful). Commercial implementation of REXS was launched in the first quarter of 2009. Its further development will be focused on recording of the project parameters dependence on the time of its implementation (such as inflation, etc.). It gives possibility not only to calculate the static indicators, but also to predict the development of projects environment in the future.

9.5 The forecasting of football games results

Perhaps, various intellectual tasks can be solved using the developed models and methods. But since they are based on the calculation of the effect on those or other categories of subject area, the most popular task is the task of predicting the state of these categories. That corresponds, as it is shown in Part 7 of the monograph "Introduction to informatics of nature", to the predictions character of activity of natural intelligent systems, i.e. people. Really we always predict and plan our future. Examples of solutions of "serious" prediction problems using reflex intelligent systems is given in the monograph "Introduction to informatics of nature". Why are these systems better than humans? Firstly, they consider only the information that relates to the problem of predicting. Secondly, we can always "look into the brain" of such system and see the basis on which any decision is recommended. Thirdly, such systems are almost unlimited either in the amount or the speed of information perception.

It is important to choose familiar subject area to confirm the effectiveness of the developed approach; predicting the development of this area, to show simplicity and efficiency of the reflex intelligent systems. It may be the realm of politics, finance or sports events. The program of universal simulation of interactions (US) was developed exactly to predict the outcome of sports games. The experimental verification of theoretical results was the purpose of this development, as well as the satisfaction of one's own curiosity. As a result, the US program correctly predicts the outcome of the football games with a probability of 0.55–0.68 (for different tournaments), and the score with a probability of 0.12–0.18. You can compare this result with your own successes in this area. Although the author is a football-fan, his prognosis is less correct.

Prediction of football matches results is based on three different algorithms:

Teams rating. Reflects the value of the team impact on the match outcome. The rating is calculated automatically as predicted percentage of obtained points in matches with some standard team whose rating equals 50.

Universal simulation algorithm (US) that considers only the most influencing factors. This algorithm implements method 1. Only those

factors are considered as effecting objects that have above threshold influence on the match result.

Universal simulation algorithm (US) that considers all influencing factors. According to past football matches' results, the program forms statistical data in the context of given list of factors. Using statistics, the program calculates the effect of each factor. Under the combination of factors' influence, it predicts the posterior matches result.

The program executes:

1. Control of the mode of operation using the system-defined parameters (specified period, standings calculation algorithm, prediction modes).
2. Tournaments, teams, countries directories maintenance.
3. Tournaments calendar maintenance.
4. Game results updating (including the results of 11-metre penalty shootouts).
5. Punitive measures denoting (the subtraction of the team's points, results cancellation).
6. Standings calculation specified by user (actual games table, prognosis table, home and away games table, group table, etc).
7. UEFA team coefficients' automatic calculation.
8. Reporting: game results; team ranking changes; prognosis results; "sensations"; cup statistics.
9. Score and outcome prediction (win, draw, loss).
10. Prognosis explanation.
11. Automatic generating of factors that influence the result.
12. Changing of the list of factors that influence the result.
13. Past games statistics.
14. Prognosis statistics maintenance.

The main working screen of the US program is shown at the Fig.9.3. The tabs of the working screen, displayed at the Fig.9.3, provide the execution of features stated in the Table 9.2. The calculation of the teams' rating and the calculation of factors' impact on the matches' results are in the basis of the football matches' results' prognosis. In the basis of calculations there is the algorithm which is based on the introformational method 1 of the evaluation of joint conditional probability by the partial ones (see Part 6). The algorithm is described in more details in the work [31].

Table 9.2

Tabs of the US program working screen

№	Tab	Features
1.	Result	Keeping of the calendar and results of the games
2.	Prognosis	Review of games' prognosis
3.	Table	Calculation and review of standing
4	Rating	Review of teams' rating
5	Teams	Reference of teams (clubs and national teams)
6	Tournament	The list of tournaments
7	Participants	The list and conditions of participation of teams in the tournament
8	Countries	UEFA indexes' table
9	Explanation	Prognosis' explanation
10	Settings	Setting of the system parameters
11	Reports	Receiving of the reports

Probability of the correct prediction outcome and score of the matches is shown in Table 9.3. As you can see, these results indicate the applicability of the introformational approach for predicting the results of sport games.

Table 9.3

Game results prediction by US program

№	Tournament	By main factors (% of correct predictions)		By all factors (% of correct predictions)	
		Outcome	Score	Outcome	Score
1.	UEFA EURO 2008	61	3	58	19
2.	Ukrainian Premier League 2009-2010	56	17	54	17
3.	FIFA World Cup Qualifications 2010	68	16	67	14
4.	Ukrainian Premier League 2009-2010	62	10	61	8
5.	Ukrainian Cup 2009-2010	79	21	75	14
6.	UEFA Champions League 2009-2010	56	15	54	15
7.	UEFA Europa League 2009-2010	57	8	52	11
8.	Total	59	14	57	13

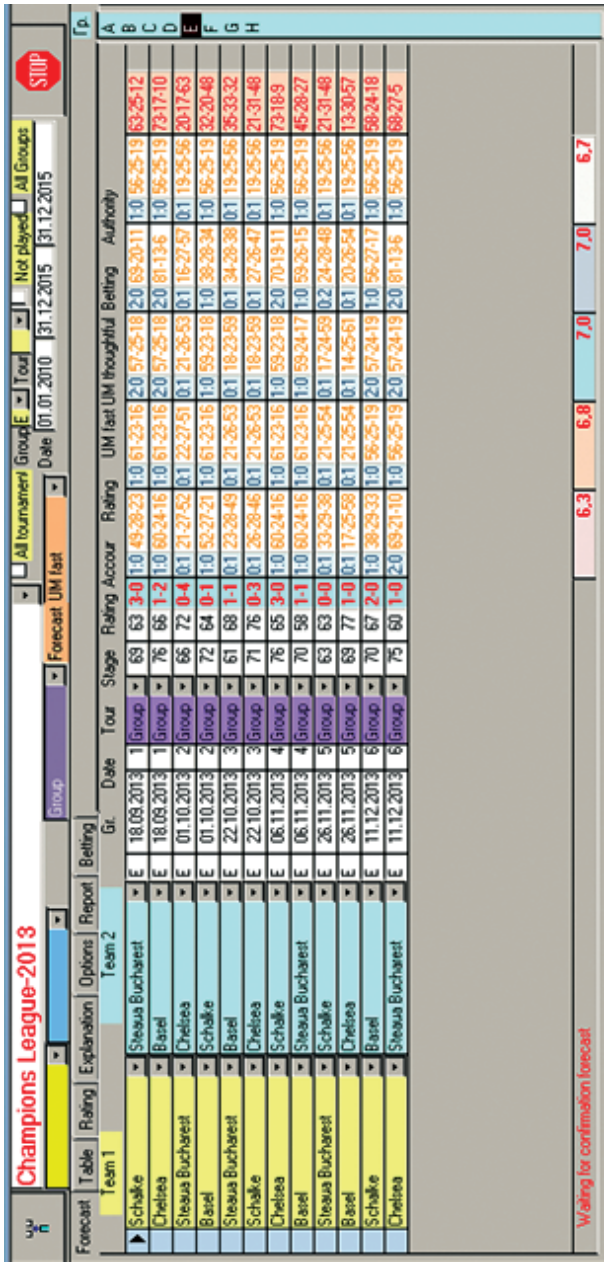


Fig. 9.3. Main working screen of US program

LOGIC OF PRESENTATION AND PRINCIPAL RESULTS

1. In order to create artificial intelligence, it is necessary to understand the nature of human intellectual activity. The basis of such activity is reflexes. There are a lot of researches in this area. But the author has found that it is not enough to study the neurons mechanism to disclose the nature of human intellectual activity; creation of artificial neural structures is needed. It is necessary to reveal the laws of Nature that are in the basis of human intellectual activity. The author suggested that there is a universal mechanism of information operating in Nature that is based on the general laws of the Universe. So the feature of this work is the usage of more general Nature laws for human reflex activity modelling than the laws of the neural structures functioning (Part 1).

2. If the laws are general and work for all material objects, it is possible to transfer understanding of the information role at the level of human activity to all material objects. The information in people's lives reflects their internal organization (neural structures). The internal organization (information that can be represented by the internal organisation) forms the behaviour of people. Then, by analogy, the internal organisation of each material object forms its manifestation. Motion is the single form of material objects' manifestation in Nature. It turns out that the motion of material objects in Nature is not the result of external force; it is caused by the "internal will" of the material entity, by its internal organisation. Such a universal (for the material objects) internal organization is called introformation. (Part 2).

3. A model of motion is suggested; model based on the hypothesis that in Nature there is just one displacement speed – the speed of light

in vacuum – *c*. And the observed velocities are much smaller and are explained by its probabilistic nature. Each object in each time slot is displaced to/against the given direction with a probability that is formed by its introformation. In fact introformation reflects the attitude of material entity to the direction of motion (Part 2).

4. The philosophical and logical explanation is given; an explanation of the introformation's nature and its role in the formation of the unity/opposition of moving material objects (Part 3).

5. The supposed mechanism of non-forceful interaction is presented; such mechanism modifies the introformational content of material objects. It is shown that all forceful interactions can be represented as non-forceful due to informational reasons. Implementation mechanism of such non-forceful interactions is based on the immediate change of the internal organization (introformation) of material objects, which, in its turn, leads to changes in their manifestation – in the movement (but not by the curvature of space-time continuum) (Part 4).

6. ***Vip***-interpretation of motion is proposed; it combines velocity, probability of displacement and the introformation quantity into a single system; also it provides an explanation for the findings of the special theory of relativity. From the proposed Vip-interpretation of motion numerical measures of introformation are obtained, i.e. certainty (confidence), and awareness (Part 5).

7. The usage of *Vip*-interpretation of motion for a series of physical laws allows presenting the formulae for introformation operation that reflect laws implemented in Nature (in its informational processor – the processor that converts introformational content of material objects during their non-forceful interaction). On this basis the introformation model was proposed; this model reflects the changes in the internal organization of material objects during their interaction (Parts 5 and 6).

8. The assumption about the reflex nature of all the matter was proposed, both animate and inanimate. The laws of motion in Nature are possible not to be "created" together with the Universe, but to be the result of development (learning) of the matter throughout all the period of its existence (Part 5).

9. Introformational methods were developed; these methods operate the introformation as Nature does it using physical laws (Part 6).

10. Experimental studies were carried out; studies that confirm the applicability of the methods for natural-language processing. More precisely, the experiments showed that the statistical regularities in natural language correspond to those predicted by introformational methods that are based on introformation model of transformation of the material objects internal organization during their interaction (Part 7).

11. An explanation of human nature and society were given; explanation from the standpoint of the unity of the introformation existence laws for all forms and levels of matter representation (Part 8).

12. Results of development and operation testing of reflex intelligent systems were carried out; systems are based on developed models and methods that reflect the laws of the functioning of Nature's informational processor (Part 9).

PRINCIPAL TERMS AND DEFINITIONS

Introformation	is internal organisation of material objects which reflects their attitude towards the truth (reality) and is the source of their manifestation (apparition to the World).
Information	is the property of objects and processes to form a variety of states, which are transmitted by displaying from one object to another and remain in its structure (perhaps in a modified form)
Awareness	is numeric measure of introformation, which characterises the authenticity of the certainty of material object (how significant the volume of information is that has formed such a certainty)
Quantum (slot) of time	is a unit of time during which a material object displaces for one quantum of distance (Plank time)
Quantum of distance	is the size of one displacement of a material object (Plank length)
Material object	is something that has a property to displace for minimum possible distance (Plank length) per minimum possible time (Plank time) and which manifests its attitude to the truth (direction of motion) through a set of displacements
Material object	is something that has a property to displace for minimum possible distance (Plank length) per minimum possible time (Plank time) and which manifests its attitude to the truth (direction of motion) through a set of displacements

Certainty	is a numeric measure of preference in the choice of displacement direction of material object (in the choice of one of the alternative variants of manifestation)
Attitude towards the truth (reality)	is a positive or negative perception of environment evoked by the condition of reality (manifestation of other material objects).
Subject domain	is an area of activity, field of application of efforts, sphere where a person acts, and which consists of the objects and relations
Manifestation of the material object	is a displacement in space (change of coordinates), a single motion, and an action.

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ANNOTATION

In the basis of the work there is the assumption lying that all interactions in Nature are caused by the information reasons, and their laws are uniform at all levels of the organization of the matter. Therefore, non-forceful (introformational) interaction of a person should have analogue and at Nature's micro level. In the evidence of this it has been shown that the representation of motion through internal (informational) functionality of material objects considerably simplifies, explains and makes intelligent a number of physical laws. Introduction of such internal functionality in formulae of physical laws has allowed constructing mathematical model that describes possible algorithm of functioning of the informational processor of Nature at different levels of the organization of the matter.

The experimental researches which have shown correspondence of received expressions to processes in areas of human intellectual activity have been conducted. Methods of construction and algorithms of systems of natural language access to databases, forecasting of results of sport games, evaluation of investment offers, assessment and forecasting of sickness risks, all of which are based on information interpretation of laws of interaction, are presented.

Connection in the work of physical laws with presumed informational original cause of manifestation of material objects has allowed formalising and uniting physical and informational aspects of life through a prism of generality of laws of non-forceful interaction in Nature.

Наукове видання

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NON-FORCEFUL NATURE

Monograph

Підписано до друку 3.10.2014.
Формат 60x84 1/16. Папір офсетний.
Умов. друк. арк. 11,12. Гарнітура Times.
Зам. № 1256. Тираж 300 прим.

Видавець: Чабаненко Ю. А.
Свідоцтво про внесення
до Державного реєстру видавців
серія ДК № 1898 від 11. 08. 2004 р.
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