Jerzy KOROSTIL[1], Olesya AFANASYEWA[2], Olga KOROSTIL[3]

[1] State University of Applied Sciences in Nowy Sącz, Institute of Technology, 33-300 Nowy Sącz, Zamenhofa 1a street, e-mail: jkorostil3@gmail.com
[2] Pedagogical University in Krakow, Institute of Technical Sciences, 30-084 Kraków, Podchorążych 2 street, e-mail: olesia.afanasieva@up.krakow.pl
[3] PSChem Sp. z o.o., 00-052 Warszawa, Świętokrzyska 18 street, e-mail: jkorostil3@gmail.com

Basic concepts of text models and their possible usage

Abstract

The paper describes the basic notions related to text models, describes the features of these models and their main differences from the known mathematical models. The definition of the semantic parameters used for the analysis of text models is introduced. The interpretation of numerical values of semantic parameters in a subject domain, which includes modeling objects, is considered.

The paper describes the method of implementation of the processes of functioning of text models. It consists of changes that occur in the text model, when the transfer of new information to the model in the form of appropriate information flows. This information is placed in the text model in accordance with the rules of synthesis of the text of the information flow with the text of the model itself, which leads to the transition of the model to a new state. The functioning of the text model is to change its state under the influence of information flows.

Illustration of ways to use text models to describe objects of different types is given.

Key words: text model, semantic parameters, social objects, interpretation of semantic parameters, semantic dictionary.

Podstawowe pojęcia dotyczące modeli tekstowych i możliwości ich wykorzystania

Streszczenie

W artykule opisano podstawowe pojęcia związane z modelami tekstowymi, cechy tych modeli oraz ich główne różnice w stosunku do znanych modeli matematycznych. Wprowadzono definicję parametrów semantycznych używanych do analizy modeli tekstowych. Rozważana jest interpretacja wartości liczbowych parametrów semantycznych w dziedzinie przedmiotowej, w tym modelowania obiektów.

W artykule zaprezentowano sposób realizacji procesów funkcjonowania modeli tekstowych. Polega ona na zmianach, jakie zachodzą w modelu tekstowym, gdy przenoszone są nowe informacje do modelu w postaci odpowiednich przepływów informacji. Informacja ta jest umieszczona w modelu tekstowym, zgodnie z zasadami syntezy tekstu przepływu informacji z tekstem modelu, co prowadzi do przejścia modelu do nowego stanu. Funkcjonowanie modelu tekstowego polega na zmianie jego stanu pod wpływem przepływów informacji.

Podano ilustrację sposobów wykorzystania modeli tekstowych do opisu obiektów różnego typu.

Słowa kluczowe: model tekstu, parametry semantyczne, obiekty społeczne, interpretacja parametrów semantycznych, słownik semantyczny.

1. Introduction

The development of informatics necessitates the use of information media in various fields of human activity. Each of the areas of activity is characterized by its own requirements for information tools. One of the typical features of many industries that combine various objects is a fairly large complexity of objects, their ambiguity and a certain blurriness of their characteristics. An example of such an industry can serve as an industry related to sociology. The peculiarity of objects related to this branch is their inability to use exact mathematical tools, including blurred mathematics, for their description, which would provide the necessary measure of the adequacy and constructiveness of such a description (Maki, Thompson, 1973). The most typical examples of such objects are social objects (SO_i), which represent formal or non-formal associations of people and are characterized by the above-mentioned peculiarities. Another example of such type of objects can be the complex technical objects (CTO), which are described by the relevant technical documentation.

The paper describes the new method developed by the authors for the construction and use of models of complex objects, the parameters of which are characterized by significant vagueness and ambiguity.

The maximum adequacy of the description of an arbitrary object may be provided by a text description form. In order for such a textual description to provide one or another measure of constructivity, the text must be presented in a form suitable for its analysis. This can be achieved by introducing restrictions on the form of representation of the text, which are described by additional syntactic rules, which leads to the normalization of the form of presentation of the text description. The achievement of the adequacy of the description is ensured by the use of limitations of semantic possibilities in the formation of the text. One such limitation is the formation of text descriptions based on the use of semantic dictionaries (Sc_i), which to some extent preclude the emergence of semantic ambiguities (Przepiorowski, Kaps, Marciniak, 2002). Each element of the text description is chosen from the dictionary Sc_i. In this way, the textual description of a given object will form the basis of the text model (TM_i) of the corresponding object.

The use of texts to describe objects that are hard to imagine using formal mathematical means is natural because the text can provide a sufficiently complete description of the object. Text means by their nature are intended to provide broad opportunities for the reflection of the surrounding reality used in the works of art (Piasecki, 2013). If you limit the way you create phrases, sentences, paragraphs and define a list of words that can be used to create texts for the selected subject area (W_i), then in this case, such a textual description can provide an opportunity for analysis. In this case it is assumed that, to the extent necessary, limiting the grammatical possibilities of the syntax of constructing texts and limiting the possibilities of semantic interpretation of the elements used in TM_i, it is possible to provide not only the corresponding adequacy of the descriptions and the necessary constructive possibilities for their analysis.

The authors have developed and proposed a new interpretation of semantic parameters, which allows to determine the numerical values of their and these values conduct an effective analysis of the description of TM_i and the processer of their functioning.

2. Basic concepts of text models

The use of text models to describe the process of solving individual problems allows automating the implementation of the process of their operation, the processes of their analysis and, to a certain extent, the modification of the corresponding models. The use of a textual form for describing an object, as its model, is conditioned by the need to provide the necessary measure of the adequacy of the presentation of the object (Korostil, Korostil, 2012).

Definition 1. The text model TM_i is a description of the object in the form of a text in a normalized form in the selected user language, which is formed from the words (x_{ij}) and phrases (φ_{ij}) placed in the semantic dictionary Sc_i, which contains all the necessary elements from the selected subject domain W_i, which can be written formally in the following form:

$$TM_i = \mathcal{F}[Sc_i, OM_i, Gr_i^N],$$

where $\mathcal{F}$ is a function that describes the process of formation TM_i, Gr_i^N is the grammar of the language used to describe TM_i, modified by the conditions that provide the description TM_i in the normalized form, OM_i is the object or process that is modeled.

The normalized form of description involves the absence of semantic redundancy in the text, the absence of other, possible ways of forming components of the text that can be taken excessively, and involves the use of a number of constraints on the permissible ways of forming sentences and paragraphs of the text. The transformation of an arbitrary, commonly accepted form of text into a normalized form is based on the use of additional syntax rules of the grammar of the language used to describe TM_i. Tasks for solving object-oriented objects, such as SO_i, are defined in the corresponding subject domain W_i. The basic information about W_i is described in the dictionary Sc_i. Such Sc_i is a list of all elements together with a description of their interpretation that defines their semantics, which describes W_i, and also contains a list of all dependencies between elements of W_i contained in OM_i and used to construct TM_i. Such a dictionary is a list of elements, which is formally described as:

$$x_{ij} :=< \alpha_{j1}, \dots, \alpha_{jn} > \mathbb{I} < p_{ij}, \dots, p_{jm} >$$

$$x_{ij} * x_{ik} := j[f(x_{ij}, x_{ik})] \quad (1)$$

where $x_{ij} \in W_i$ is the element used to construct TM_i, α_{jr} is the element of the text description of the interpretation of the components x_{ij}, p_{jk} is the parameter that is the extension of the text description of the interpretation x_{ij}, if it is necessary, $j[f(x_{ij}, x_{ik})]$ is a textual description of the relationship between x_{ij} and x_{ik}, which displays the semantics of the corresponding dependency and, if necessary, can be expanded by a formal description of the individual fragments $f(x_{ij}, x_{ik})$. The text model TM_i represents a certain structured text in a normalized form, which can be formally described in the following form:

$$TM_i = \{mt_{i1} * \dots * mt_{in}\},$$

where mt_{ig} is a fragment of the text with TM_i, or $mt_{ig} \in TM_i$, and "*" are functions that represent the relationships between mt_{ig} and $mt_{i,(g+1)}$. Such connections can describe arbitrary ways of continuation of elements mt_{ig} within TM_i.

Any model used to describe a particular object, through which you can describe the process of the operation of this object, and, consequently, implement on the basis of this description of the management of the process of operation of the object (Giordano, Weir, Fox, 1997). To illustrate the use of TM_i, we assume that the object of modeling is social objects SO_i. In order for the analysis TM_i to be carried out, it is necessary to introduce parameters that would characterize this form of description of the object and allow to construct the interrelations of the model with the modeling object. The most suitable parameters TM_i, for these purposes, are semantic parameters that allow us to display the information essence described in TM_i. The basic parameter is the parameter of semantic significance σ^Z (Chen, Yuan, Zhang. 2010). This parameter can be estimated by numeric value. This value should reflect the information significance of the word x_{ij}, or the phrases φ_{ij} in W_i, in relation to which parameter is used, in addition, the value of the parameter σ^Z must be adequately calculated on the basis of the analysis of the information used by the means of describing the relevant components. The most pleasant way to choose such an assessment is based on the use of expert analysis of the corresponding W_i. The possible method for determining the value of σ^Z is based on the requirements for constructing each element in Sc_i. An example of this requirement is the description of a text interpretation of the corresponding $x_{ij} \in Sc_i$ that we will denote by $j(x_{ij})$, for which the length of the text $j(x_{ij})$ in the number of words would correspond to the semantic value of the corresponding word x_{ij}, or a separate phrase. The advantage of this method of determining the value of σ^Z is that Sc_i is formed once for the selected W_i if W_i does not change in the process of functioning of the corresponding TM_i.

Definition 2. The semantic significance $\sigma^Z(\varphi_i)$ of a certain phrase φ_i from the dictionary Sc_i is determined by the number of words used for the text description of the interpretation φ_i:

$$\sigma^Z(\varphi_i) = \mathcal{F}[j(\varphi_i) =< \alpha_1, \dots, \alpha_m >] = \sum_i Sg(\alpha_i)], \quad (2)$$

where $Sg(\alpha_i)$ is described by the relation:

$$[(\alpha_i = 0) \to (Sg(\alpha_i) = 0] \vee [(\alpha_i \neq 0) \to (Sg(\alpha_i) = 1].$$

The correctness of such a definition is based on the fact that an expert in the W_i field generates a textual description of the interpretation of the word x_{ij}, or phrases based on the analysis of W_i as a whole. If in the process of using the system of text patterns (STM_i), the medium W_i expands, then $j(x_{ij})$ can also expand, which can lead to a change in the value of $\sigma^Z(x_{ij})$.

To efficiently use TM_i, you need to introduce a number of additional semantic parameters, which would allow us to expand the analytical capabilities of using TM_i. Obviously, such parameters should be interconnected and should allow for interpretation within the framework of the text descriptions and within the framework of the objects being modeled. From the point of view of the information displayed by the adjacent components of the text descriptions, the following situations may occur: two adjacent components may be contradictory, consistent with one another and may be conflicting with one another.

Definition 3. The value of the total semantic contradiction between φ_i and φ_j, or $\sigma^{ZS}(\varphi_i, \varphi_j)$ is determined by the absolute value of the difference in the values of the semantic significance of these phrases:

$$\sigma^{ZS}(\varphi_i, \varphi_j) = \left|\sigma^Z(\varphi_i) - \sigma^Z(\varphi_j)\right|.$$

In Sc_i, there is a component that has the maximum length of the text description $j(x_i)$, which is measured by the number of words whose value has a finite value, or $\max\limits_j Sg[j(x_j)] = M$ and there is a component, which has a minimal length of the text description $j(x_i)$, which is measured by the number of words, or $\min\limits_i Sg[j(x_i)] = m$. Then, the general semantic contradiction $\sigma^{ZS}(\varphi_i, \varphi_j)$ within the dictionary Sc_i has the maximum value, which is determined by the difference in the semantic meanings between the element $\varphi_i \in Sc(W_i)$, which has the maximal value of $\max \sigma^Z(\varphi_i)$, and the element $\varphi_j \in Sc(W_i)$, which has the minimum value $\min \sigma^Z(\varphi_j)$. The following relation can be written:

$$\max \sigma^{ZS}(\varphi_i, \varphi_j) = \max \sigma^Z(\varphi_i) - \min \sigma^Z(\varphi_j).$$

Let us assume that the general semantic contradiction $\sigma^{ZS}(\varphi_i, \varphi_j)$ is a set of discrete values σ^{ZS}, which can be arranged by increasing the value of the values of the parameter $\sigma^{ZS}(\varphi_i, \varphi_j)$. We arrange the value of this parameter by increasing its value, and the levels of value σ^{ZS} are replaced by one value of the total semantic contradiction. Then, such a series can be written as:

$$\sigma_1^{ZS} < \sigma_2^{ZS} < \sigma_3^{ZS} < \cdots < \sigma_n^{ZS}.$$

We can assume that the number of discrete values σ_i^{ZS}, which can be obtained on the basis of using the dimensions $j(\varphi_{ij})$ in words, is not sufficient to represent all the necessary values of semantic parameters. In this case, it is necessary to take into account the following features of the use of $j(\varphi_{ij})$.

One or another significance of $\sigma^Z(\varphi_i)$ is determined by all aspects of the importance of the separate φ_{ij} for W_i and, accordingly, the process Pr_i, which must be displayed in the text form $j(\varphi_{ij})$. If the expert does not have the necessary data on all possible aspects of the influence φ_{ij} on $Pr_i(CTO)$ or $Pr_i(SO)$, and the description of known processes requires the use of φ_{ij}, then the length of $j(\varphi_{ij})$ can be supplemented by a numerical value an additional measure of importance of φ_{ij} for Pr_i, which complements the value $\sigma^Z(\varphi_{ij})$ to the required degree of significance. In this case, the chosen numerical value, which for different φ_{ij} must be different, is added to the sum in formula (2).

It should be noted that in most practical cases, the number of discrete values $\sigma_n^{ZS}(\varphi_i, \varphi_j)$ and, consequently, the values of $\sigma^Z(\varphi_{ij})$ is not infinitely large. The number of discrete values of semantic parameters is determined by the necessary accuracy of their definition and the physical boundaries of the parameters, which are represents in the interpretative descriptions of the corresponding σ^i.

Show the magnitude of the values σ^{SZ} on the numerical axis. Point 0 of this axis corresponds to $\sigma^{ZS} = 0$. Point γ of this axis corresponds to $\sigma^{ZS} = \max \sigma^{ZS}$. We introduce on the numerical axis for σ^{ZS} points defining certain segments: $[0, \alpha]$, $[\alpha, \beta]$, $[\beta, \gamma]$.

The large dimensions of $j(\varphi_{ij})$ do not affect the speed of functioning $TM_i(CTO)$ because the values of $\sigma^Z(\varphi_{ij})$ are determined once before the operation of the system $(TM_i, Pr_i(CTO))$ and represent a certain amount.

Different values of the total semantic contradiction in the subject domain W_i may have additional interpretations. For example, certain values of $\sigma^{ZS}(\varphi_i, \varphi_j)$ may be allowed within the sentences ψ_i with TM_i. In this case, it is advisable to introduce the idea of the semantic coherence $\sigma^U(\varphi_i, \varphi_j)$. If the measure of semantic consistency is such that the value of $\sigma^{ZS}(\varphi_i, \varphi_j)$ is too small, from the point of view of interpreting the relationship between φ_i, φ_j and W_i, then it is advisable to introduce the semantic conflict $\sigma^K(\varphi_i, \varphi_j)$. We introduce the following definitions.

Definition 4. The magnitude of semantic coherence between φ_i and φ_j, or $\sigma^U(\varphi_i, \varphi_j)$ is determined by the value of the value of the total semantic contradiction of these phrases, which is determined on the selected interval of values of the total semantic contradiction $[\alpha, \beta]$:

$$\sigma^U(\varphi_i, \varphi_j) = \{\sigma^{ZS}(\varphi_i, \varphi_j) \& [\sigma^{ZS} \in [\alpha, \beta]]\},$$

where $[\alpha, \beta]$ are the limit values of the value of the total semantic contradiction for arbitrary adjacent pairs of phrases in which the value of the parameter $\sigma^U(\varphi_i, \varphi_j)$ lies in the given interval of values σ^{ZS}.

Definition 5. The magnitude of the semantic conflict between φ_i and φ_j, or $\sigma^K(\varphi_i, \varphi_j)$ is determined by the value of the total semantic contradiction of these phrases, which is in a certain range of values of total semantic contradiction $[0, \alpha]$:

$$\sigma^K(\varphi_i, \varphi_j) = \{\sigma^{ZS}(\varphi_i, \varphi_j) \& [\sigma^U \in [0, \alpha]]\},$$

where $[0, \alpha]$ are the limit values of the magnitude of the total semantic conflict, which may have arbitrary pairs of adjacent phrases.

Definition 6. The magnitude of the semantic contradiction σ^S between φ_i and φ_j, or $\sigma^S(\varphi_i, \varphi_j)$ is determined by the value of the total semantic contradiction of these phrases, which is in a certain range of values of total semantic contradiction $[\beta, \gamma]$:

$$\sigma^S(\varphi_i, \varphi_j) = \sigma^{ZS} \& [\sigma^{ZS} \in [\beta, \gamma]].$$

Warning 1. The semantic contradiction $\sigma^S(\varphi_i, \varphi_j)$ differs from the general semantic contradiction $\sigma^{ZS}(\varphi_i, \varphi_j)$ by the fact that the value $\sigma^S(\varphi_i, \varphi_j)$ lies only in a given interval of values of the total semantic contradiction.

Assuming that the intervals of the semantic parameters $\sigma^K, \sigma^U, \sigma^S$ are linearly related to each other, then the following dependence can be written which determines the change in the value of the values of the corresponding semantic parameters when the value of σ^{ZS} changes:

$$\{\sigma^K\,[0, \alpha] \rightarrow \sigma^U\,[\alpha, \beta] \rightarrow \sigma^S[\beta, \gamma]\}. \quad (3)$$

3. Structure and functioning of text models

In most cases, models based on the use of mathematical tools are constructed in such a way that the entire simulated process $Pr_i(CTO_i)$ and, to some extent, the CTO_i, implementing these processes, are reflected in the corresponding model with the necessary completeness. Due to the complexity of most processes and the most CTO_i that are subject to simulation, the model describing such a process, or CTO_i, is also quite complicated. For convenience, in the text we will talk about modeling the object, taking into account that in reality the process is being modeled by the corresponding object and therefore the corresponding model will be to some extent describe the object itself (Meyer, 2004). Let's assume that in the mathematical modeling of complex technological processes, it is necessary to take into account the following features.

1) A model that focuses on managing a technological process that functions continuously over a given time interval must function in real time.
2) Models that implement partial control $Pr_i(CTO_i)$ are used when CTO_i implements automatic control systems for individual fragments that are most functionally rich. Then, the general model solves the tasks of managing the interconnection between the individual functional components, which greatly simplifies the task of general management. This model also works in real time.
3) Within the framework of $Pr_i(CTO_i)$ there may be a number of problems whose resolution can be separated from the main management tasks $Pr_i(CTO_i)$. Such tasks will be called expanding tasks.

All tasks related to the construction of models for objects that cannot be described by the exact mathematical means because of their uncertainty, within the framework of this approach, must be solved on the basis of methods that allow for such uncertainty to be taken into account, for example, methods that use text patterns.

An example of expanding tasks can be diagnostic tasks, the task of protecting CTO_i from external threats, and others. The expanding nature of these tasks is due to the fact that they are additional to the main task of management (Isermann, 2000).

Each of the following expansion tasks should contain information about CTO_i, since these tasks relate to the object as a whole. The initial conditions for expanding tasks are blurred and, in most cases, are not precisely defined, although solving these problems relates to factors that influence the various fragments of the control object. To construct models that can be used to solve such problems, it is advisable to use text models. Text models can provide the required adequacy of description and a given degree of constructivity. Constructivity of the model means that it provides the possibility of a sufficiently complete analysis of the modeled object, not only on a qualitative level, but also on the quantitative level of study of its characteristics and characteristics. This is achieved by using text to describe everything that should be reflected in the model. Due to the use of semantic parameters with their numerical interpretation, and if necessary, semantic parameters, expanded by technological parameters, it becomes possible to provide the necessary measure of the constructivity of such models.

The construction of text patterns consists of the following steps.

Formation of the initial version of the text description of the object (PVO), which is supposed to be simulated, is realized on the basis of the use of generally accepted grammatical rules of the language in which this text is formed. If an object contains technical or other documentation that contains a description of this object, then such documentation is accepted as the initial version of the text description.

On the basis of the PVO analysis, a semantic dictionary Sc_i is formed, in which only the components x_{ij} and φ_{ij} are introduced, which do not represent any semantic redundancy, which is determined during the expert analysis of W_i, as well as Sc_i include functional links The links between the components that are key to the relevant object. For each component a textual description of its interpretation is formed, the adequacy of which for the corresponding component is determined on the basis of expert data about the modeling object.

In Sc_i, for each component $\varphi_i, j(\varphi_i)$ is formed in such a way that its semantic meaning $\sigma^Z(\varphi_i)$ can be determined in the chosen method, for example, the length of the text description $j(\varphi_i)$, which is measured by the number of words, or by assigning a corresponding numerical value of semantic significance that can be established on the basis of expert data, or $\sigma^Z(\varphi_i)$ can be determined by the sum of the length $j(\varphi_i)$ and the additional numerical value. In this case, an additional numeric value affecting the value of $\sigma^Z(\varphi_i)$ must be different for the various components φ_i.

The text from the PVO is converted into a normalized form based on the use of additional rules for the normalization of texts, in relation to the rules of grammar, defining its syntax. For example, the rules for removing synonyms and repetitions and other imperfections, rules that restrict the way of describing the interdependencies between elements of the text and others.

Based on the analysis of the descriptions of the interpretation of the subject area of the simulation object, the limit values for the values of semantic parameters are set that are common to all TM_i of W_i and are located in the text analysis system (SAT), which is common to all W_i, and all TM_i (Broda, Derwojedowa, Piasecki, 2008).

The textual description TM_i is further structured in such a way that the following was structurally allocated in TM_i:

- general information about simulation object,
- the main structural fragments TM_i are placed in a sequence that corresponds to the sequence of the implementation of the functioning $Pr_i(CTO)$,
- the text model is supplemented by additional links that define the links between the fragments TM_i, which complement and extend the links, which are displayed by the sequence of text fragments in TM_i.

The functioning of processes implemented within the framework of expanding tasks, which are described in the text form in TM_i, are characterized by speeds that are significantly less than the speeds of the operation of the main technological processes of the CTO. The overall speed of the process of occurrence of malfunctions, or the occurrence of dangers, if measured during the entire period of full-time functioning $Pr_i(CTO)$, is less than the speed of the operation of processes corresponding to the regular modes of their operation. This leads to the fact that in the text model of expanding tasks there should not be components that provide a reflection of the change process in TM_i, which must describe the dynamics of the simulated processes. Therefore, changes in TM_i are activated and implemented by an external means, in cases where such changes are necessary, and an example of such a means may be SAT. Activation of TM_i is conditioned by occurrence in an environment in which TM_i is used, information flows (IP_i) that are transmitted to TM_i. Synthesis of TM_i and IP_i, which leads to changes in TM_i, which reflect the dynamics of the functioning of the model TM_i, is realized by the SAT system. An example of such flows for SO_i can serve as information programs targeted at certain groups of people, and for objects such as CTO_i, an example of such flows can be information about the output technical parameter value beyond the permissible limits, which is a flow value of the parameter value and text description of its interpretation, etc.

Definition 7. The sequence of changes in TM_i under the action of individual IP_i represents the process of functioning TM_i, which reflects the dynamics of the processes of the solution of expansion problems affecting $Pr_i(CTO_i)$.

This process is formally described by the relation:

$$SAT(TM_i \rightarrow TM_{i+1} \rightarrow, \ldots, \rightarrow TM_m).$$

The sequence of changes of TM_i is the process of functioning of the model of TM_i type. One of the differences in the model TM_i from the model $M[(Pr_i(CTO)]$ lies in the fact that the speed of the model TM_i functioning in real time is much smaller than the speed of the functioning of the model $M[(Pr_i(CTO)]$ in real time.

4. General description of examples of using text models

Since TM_i is a textual description of some object or process, and the main feature of the functioning of any model is the changes that occur in it and these changes are subject not only to the registration a and to the interpretation of the processes occurring in the simulated object, then it is necessary to determine with such changes in TM_i and establish the connection of these changes with the processes occurring in the corresponding objects.

Changes that can occur in TM_i are displayed by changes in texts. Such changes should allow for their interpretation in the modeling object. Therefore, let's consider the correlation of the change in the texts of TM_i with the processes occurring in the simulated object at a qualitative level. Let's assume that objects that are of different nature will be modeled. One example of such an object might be a social object SO_i, and another example would be the complex technical object CTO_i (Blanke, Kinnaert, Lunze, 2006).

The case where the object of the simulation is SO_i, is most characteristic of using models TM_i. This specificity is due to the fact that, basically, the speed of processes in models SO_i and speed of processes that occur in $TM_i(SO_i)$, is proportional. It is also characteristic of processes that by their nature are slowly changing. Examples of such processes can be economic processes, a number of natural processes, and others.

The interaction process between IP_i and SO_i is modeled by the implementation of the synthesis IP_i with $TM_i(SO_i)$. Individuals from SO_i in most cases accept text form of information, and use the text form of information, for the implementation of the exchange of information on the environment. The consequence of perceiving information by the object SO_i may be those or other actions on the side of SO_i, which, due to such information, are activated. This circumstance may be interpreted as the result of an appropriate jet of text information that can be considered as the control information acting on SO_i. Based on hypotheses and some provisions taking place in psychological research on the mechanisms of human perception of information in text form, it can be assumed that the semantic parameters are most suitable to describe possible processes of perception, or rejection of human perception of textual information (Bavishi, Slade, Levy, 2016). According to a hypothesis about human perception of textual information, the effectiveness of the perception of information depends, for example, the degree of semantic consistency of the text that is transmitted to humans from the textual interpretation of information that are related to the text that displays the information held by the relevant person, besides individual the person may be related to the semantic essence of information that is transmitted to SO_i. The semantic parameters of text information that an individual can perceive, for example, describes how it influences different aspects of interpreting this information. One example of this aspect of perception interpretation can be the information of received ideas about consciousness, understanding the principles or criteria that determine the possibility of making the information transmitted by individuals and, therefore, the individual decision of one or other decisions, etc. In this connection, additional semantic parameters can be introduced based on the basic semantic parameters $\sigma^Z, \sigma^S, \sigma^U, \sigma^K$. Such parameters may be more closely related to the interpretation of the textual presentation of information held by an individual characterizing various aspects of the perception and use of this information. One of the peculiarities of using TM_i to describe and control SO_i is the complexity of the implementation of the inverse relationship between SO_i and TM_i.

When the modeling object is CTO_i, there is documentation for each CTO_i, which is largely a text description of CTO_i. The transformation of the technical documentation into $TM_i(CTO_i)$ is the possible replacement or addition, with a certain approximation, for the purpose of textual displaying of the information content of graphic images and mathematical formulas, or of their fragments, which are in the documentation. This text form is further normalized, and the text fragments of the description CTO_i are directly converted into a normalized form. In most cases, to solve the control tasks of CTO_i, complex mathematical models are used that adequately describe the process of functioning of the corresponding object. Text models are more focused on solving problems that are characterized by a high degree of uncertainty. In the problem of ensuring the reliability of the CTO_i functioning, there are a number of problems whose conditions of resolution can not be determined with the necessary accuracy. These tasks include diagnostic tasks CTO_i, tasks for ensuring the safety of functioning CTO_i and others.

Consider the method of constructing a diagnostic system for CTO_i based on the use of TM_i on a qualitative level. The occurrence of malfunctions may be expected and unexpected, which are called design and non-design malfunctions (Korbicz, Kościelny, Kowalczuk, 2004). Fault Diagnosis: Models, artificial intelligence methods, applications. Springer.

Not design faults by nature are not sufficiently defined. Consider the method of detecting non-design faults, based on the use of TM_i. Since the TM_i model is structured, there are fragments in it, in which some subprocesses of the general operation process CTO_i are described. In the case of CTO_i, information is transmitted to $TM_i(CTO_i)$ in the form of text information streams, including flow parameters of the parameters, the interpretation of the component $x_{ij} \in W_i$, and the interpretative description of the corresponding values of the parameters that are in Sc_i, regardless of whether the value of the parameter is within the permissible limits. In determining $\sigma^Z(x_{ij})$, the value of this parameter depends not only on the size of the text description of the interpretation $j(x_{ij})$, but also on the fluid value of each of the parameters p_{ij} that are related to x_{ij} in the ratio (1). In this relation, each p_{ij} is given in the form of a sequence of interval values that the corresponding parameter can take and in the form of corresponding interpretation descriptions of the influence of β_i on $Pr_i(CTO)$, which is written in the form:

$$p_{ij} \coloneqq [\beta_1(d_1 * d_2), j(\beta_1); \beta_2(d_2 * d_3), j(\beta_2); \dots; \beta_k\big(d_{(k-1)} * d_k\big), j(\beta_k)],$$

where β_i is the serial number of the interval, "*" is a function of changing the value p_{ij} on the interval β_i, which in most cases is linear, $\big(d_{(i-1)}, d_i\big)$ is the boundary value of the interval, $j(\beta_i)$ is a text description of the interpretation β_i describing the effect of the values of the parameter on the interval β_i on $Pr_i(CTO)$. Assume that the interval $\beta_i\big(d_{(i-1)} * d_i\big)$ corresponds to the given mode of operation of the process $Pr_i(CTO_i)$. In this case, σ^Z is determined on the basis of the size $j(x_{ij})$ and the coefficient, assigned in accordance with the data of the expert analysis, for each interval $\beta_i \Delta d_i$. The process of functioning of TM_i is realized by separate means, including technical ones, in relation to the means of implementation of $Pr_i(CTO_i)$. Therefore, only the exchange of information in the form of the transfer IP_i in the process of functioning $Pr_i(CTO_i)$ takes place between the environment $Pr_i(CTO_i)$ and $TM_i(CTO_i)$. The analysis of the parameters obtained and their deviations are realized in parallel with $Pr_i(CTO_i)$ in the medium $TM_i(CTO_i)$. If in the process of working $Pr_i(CTO_i)$ it turns out that the value of the parameter p_{ij} has changed and moved to another interval $\beta_j \Delta d_j$, then the corresponding value $\sigma^Z(x_{ij})$ will be changed by changing the interval β_i for the corresponding element x_{ij} or φ_{ij} and the information about it is transmitted to Sc_i and SAT. The SAT system in TM_i detects a pair of phrases for which the value $\sigma^Z(x_{ij})$ has changed. This can lead to unacceptable changes in the value of σ^U, σ^K or σ^S, or to the transition of the corresponding semantic parameter σ^U into the ranges of determination of other semantic parameters σ^S, or σ^K according to formula (3). The corresponding change of σ^U can be detected in an arbitrary fragment mt_{ij} of the model $TM_i = \{mt_{i1} * \dots * mt_{im}\}$ even before the change in the value of the parameter p_{ij} starts to affect the function of the corresponding fragment mt_{ij} of the subprocess of functioning $pr_{ij} \in Pr_i(CTO_i)$ and in general on $Pr_i(CTO_i)$. Thus, the problem of determining the place of failure in $Pr_i(CTO_i)$ is solved. Based on the analysis of a fragment of text, which revealed a semantic anomaly and analysis of a parameter whose value passed beyond the established boundaries, one can determine the nature of the possible malfunction (Kidd, Castano, 2013).

Unlike the classical approaches to the solution of diagnostic tasks, in the case of TM_i, monitoring of possible diagnostic parameters is implemented not in accordance with the chosen strategy, but activated in case of changes in the semantic significance σ^Z of individual components. Such monitoring is carried out within the framework of the TM_i model, which is not part of the tools that implement process control management $Pr_i(CTO_i)$ and, therefore, does not result in the use of resources that require $Pr_i(CTO_i)$.

The next difference is that due to the analysis of semantic parameters in TM_i, it is possible to detect possible deviations in $Pr_i(CTO_i)$ at a stage when $Pr_i(CTO_i)$ has not yet reached the state in which the detected deviations can affect the normal mode of operation $Pr_i(CTO_i)$. This possibility is conditioned not only by the fact that the detection of a semantic anomaly and its elimination can be carried out before the transition of $Pr_i(CTO_i)$ into a state in which the corresponding anomaly can affect $Pr_i(CTO_i)$, but also because the anomaly can be detected in the fragment $pr_{ij} \in Pr_i(CTO_i)$ which is activated when the mode of operation $Pr_i(CTO_i)$ changes, which may not depend from the real-time operation of the technological process, but depends on the conditions that determine the need to switch from one mode of operation $Pr_i(CTO_i)$ to another.

5. Conclusions

The paper presents the basic concepts of text models, describes the principles of their use, and simulates various types of objects.

The analysis of the main features of the description of the operation of text models, their differences from the description of the processes of the functioning of mathematical models is carried out. The necessity of using additional means for realization of the functioning of TM_i is shown.

In this paper, the basic semantic parameters are determined which allow to carry out quantitative analysis of the basic properties of text fragments TM_i and describes the interpretation of these parameters and their connection with the subject domain, which includes the selected modeling objects.

Examples of the method of use TM_i for modeling the influence of information flows on social objects and the method of use TM_i, for solving problems of diagnostics of complex technical objects, are described on a qualitative level.

An approach to constructing and using TM_i, for the simulation of processes that slowly change over time, in relation to the basic processes, allows solving expanding tasks, for example, diagnostic tasks. This allows you to build descriptions of the processes of functioning of the relevant objects with the necessary completeness of their reflection, which provides the possibility of a successful solution to diagnostic tasks. The given semantic parameters provide an opportunity, in the process of analysis of the corresponding models, to obtain quantitative characteristics of possible changes in the basic processes of the functioning of objects, in relation to which the problems of expansion are solved.

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