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Using text models in systems of control of social objects

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Abstract

This work introduces a method of building and using text models for the analysis and control of social objects. Social objects are groups of people united in informal organizations based on common interests and goals. The main tools to control social objects are information flows used by mass media.

We examine different ways of using semantic parameters to analyze text models. This work contains research of implementation methods to monitor currently used social Internet networks and to provide feedback between the social objects and the control system.

Introduction

Controlling social objects is a typical function of any structure which unites certain objects into a social system. Depending on the development of tools of communication and control processes implementation, the control tasks may be solved with different efficiency. The task to control social objects is always considered in the specific scope of activity, which is the uniting factor while forming separate social objects (SO_i). Thanks to the development of information tools it is now possible to create information technologies which allow the automation of the processes of creation of control systems for certain objects.

According to the basic principles of automated control theory, regardless of the type of object which is supposed to be controlled, the following requirements have to be met to implement automated control (Gostev & Steklov, 1998; Tu, 1971):

- means to control an object must be created;
- feedback between the control system and control objects is required;
- there must be tools for modeling a control object.

The basic control tool for social objects is certain information or an information flow (IP_i) which is implemented in the mass media. Examples of such tools are television, press, etc. Feedback is relatively non-determined and consists of different options of social objects and individuals to transfer information about the effects of a corresponding package IP_i. Previously there were no tools for modeling social objects, and the proposed ones often proved not to be entirely appropriate for a modeled object. As the Internet network became advanced, computer networks started to be widely used as tools for communication and transfer of IP_i. This has brought to life numerous social networks available for information exchange between individuals. Search systems began to allow the execution of a network search based on the given profiles of information creators, or authors, which transfer mostly author-related information in these systems. Thanks to these tools, feedback is provided between social objects and the control system. This work covers the examination and research of tools for modeling a totality of social objects. Analysis of such models makes it possible to create controlling IP_i for corresponding SO_i.

Modeling of social objects

Social objects, needing to be controlled and directed, are groups of individuals who are united on the basis of their own initiative or create informal unions based on common interests. Such formal union represents a structured group of people who could be united because of a corresponding control operation of the control system. These unions and the structure of their organization are called state-owned or private enterprises. SO_i, which are needed for modeling, also include groups of individuals formed through initiatives not authorized by the control system of the state. In such cases modeling tools for SO_i are formed during the following stages:

- initial stage;
- identification stage;
- control stage.

During the initial stage an initial version of a text model (TM_i^P) is formed, related to the chosen types of SO_i (Korostil & Korostil, 2012; 2013a). The text model represents a text description of a group of individuals chosen by experts for the implementation of the control system. Initial data for building of a TM_i^P are data confirming that groups of a certain type can exist, while their method of functioning, their nature and other parameters can be hypothetical.

The identification stage consists of using the information gathered from monitoring a social environment, which confirms the existence of social objects described during the initial stage. Among the data gathered by monitoring, the selection is made towards the ones matching the defined parameters of social groups which were foreseen during the initial stage of model forming.

During the control stage, processes of controlling SO_i are put into effect on the basis of using information flows which form in the scope of control systems. This stage implements modification of SO_i descriptions which are essentially TM_i within the boundaries of the system. Such modification at the first step of control is performed by fusing the controlling IP_i and the corresponding TM_i. At the second step the IP_i are transferred to the corresponding SO_i. At the third step, on the basis of data gathered while using the system of social environment monitoring, the final modification of the corresponding TM_i is performed.

A system of social environment control consists not only of TM_i which model SO_i, but also includes the following components:

- system of IP_i creation or IP_i generation;
- system of analysis of current SO_i state and social environment (*SSO*);
- system of decision making which performs certain SO_i control.

The system of IP_i forming, further named *DIP*, represents a structure, organized in a certain way, of tools to create text messages, instructions, orders or recommendations intended for transfer to the corresponding SO_i. Because different SO_i have different parameters or other characteristics, the corresponding IP_i must take these differences into account. Thus, *DIP* functioning is closely related to the tools of SO_i analysis.

The system of decision making (SPR) which performs control operations is closely related to *DIP* because, in the scope of this system, a necessity or suitability is determined to influence on SO_i in one way or another. During its work the SPR system is using criteria, goals and other factors which lead to the implementation of control processes. This system initializes the processes of IP_i creation, relying not only on analysis of SO_i current state, but also on common data about *SSO* and the goals of system functioning. This component is the most open and allows the modification of the criteria and principles of its functioning.

The system of current state analysis consists of the following components, directly related to TM_i:

- components of *SSO* monitoring;
- components of TM_i semantic analysis;
- components of IP_i fusion with TM_i.

The monitoring system (*SM*) implements feedback functions of the global control system (*ZSU*) with the control objects. Such feedback is not fully direct because it is activated, not strictly after the appearance of any changes that occurred in SO_i, but rather relying on whether individuals which are part of the corresponding SO_i give information about such changes in the media monitored by the *SM* system. In this case the task arises of bringing the *SSO* monitoring disciplines as close as possible to the state which would correspond to the mode of direct feedback functioning (Korostil & Korostil, 2014).

The functioning of TM_i semantic analysis components is based on the use of semantic parameters. Because TM_i is a certain text written in user language, the latter is characterized by certain semantics and structure which supplements it. We will not take into consideration other possible text characteristics because they are mostly of a technical type (Panfilov, 1971; Vardul, 2006).

The component of IP_i fusion with TM_i is one of the key components. It implements the modeling of the interaction process of real SO_i with IP_i, which are transferred to SO_i from the *SSO* control system. The process of IP_i fusion with TM_i is the key stage of SO_i control process implementation and it lies in determining the following characteristics of IP_i as a key factor influencing the real SO_i:

- possible efficiency of IP_i influence on SO_i;
- IP_i compliance with the goal of IP_i's influence on SO_i;
- suitability of implementation of IP_i controlling influence on SO_i regardless of chosen goal of this influence.

Text models of social objects

Objects such as groups of individuals, united by certain goals and tasks, are hard to describe formally so that the descriptions can be adequate and constructive enough. To ensure the necessary adequacy, SO_i are described using text description forms written in user language which are presented in normalized form. Normalized form requires using extended rules of phrase and sentence composition as well as using semantic vocabularies. Such extensions and semantic vocabularies ensure strict meanings of composed phrases and sentences because any semantic or syntax excessiveness is excluded. Semantic vocabularies make it possible to use numeric estimations of the corresponding parameters while analyzing text descriptions. This factor enables constructive analysis of researched objects. The text model is formally described by this relation:

$$TM_i = \{\psi_i[\varphi_{i1}(x_{11},\cdots,x_{1k}),\cdots,\varphi_{i+j}(x_{j1},\cdots,x_{j,m})],\cdots, \psi_{i+r}[\varphi_{(i+r)1}(x_{11},\cdots,x_{1g}),\cdots,\varphi_{(i+r+q)}(x_{q1},\cdots,x_{q,e})]\} \quad (1)$$

Here, ψ_i is a text sentence, φ_{ij} is a phrase, and $x_{j,m}$ is a word. To build TM_i, words or phrases from semantic vocabulary S_C are used. Semantic vocabulary is a description of a subject area W_i for which text models are used. The subject area W_i for SO_i consists of data regarding a corresponding group of individuals. These data represent information about goals that unite the individuals, about the type of connection between individuals, the type of functioning of separate members in SO_i and the social object as a whole. Semantic vocabulary S_C is described by this relation:

$$S_C := x_1 = \langle a_{11} * \cdots * a_{1m}\rangle,\cdots,x_n = \langle a_{n1},\cdots,a_{nk}\rangle \quad (2)$$

Here, a_{ij} are words describing the interpretation of the corresponding elements. Text interpretation of a word x_{ij} can be represented as the following relation: $x_i = j(x_i)$, where $j(x_i) = \langle a_{i1}*\ldots*a_{im}\rangle$.

To implement the possibilities of a constructive analysis, semantic parameters are used (Korostil & Korostil, 2013b; Boyun, 2001). These parameters are as follows:

- semantic significance σ^Z;
- semantic contradiction σ^S;
- semantic conflict σ^K;
- semantic consistency σ^u.

The list of semantic parameters can be expanded by other entries. Whether or not such expansion is necessary depends on the specification of the problem at hand.

Information flows which are implied to be transferred to SO_i and fused with TM_i are text forms formally described as following: $IP_i = \{ip_1*\ldots*ip_m\}$. For its fusion with TM_i, IP_i is converted to the normalized form. The fusion of TM_i and IP_i leads to changes in TM_i^* description which correspond to the changes taking place in SO_i during the perception of the corresponding IP_i (Korostil & Korostil, 2013b; Boyun, 2001).

Semantic parameters σ^Z, σ^S, σ^K have their interpretation in SO_i objects. This interpretation represents the basic characteristics of certain individuals from SO_i as well as SO_i in general. For example, semantic significance of a component in TM_i is related to the significance of a corresponding feature, element or individual which is a part of SO_i. Semantic contradiction represents the measure of coordination between individuals regarding various factors which belong to their objects of activities, etc.

Implementation of strategy of social object control

Influencing SO_i with a single IP_i is not enough to control social objects. This can be explained by the fact that in a certain group of individuals there may be no simultaneous identical response to received information from all group members, if this group has no obligations to a certain social organization which imposes predetermined responses to received information. More than that, incomplete perception of information is also possible, which depends on the individual features of every single member. Thus, to perform control successfully, it is necessary to implement a series of information influences on SO_i by some sequence IP_i, that can differ from each other but are all oriented towards performing an influence defined by the control goal C_i. Such sequence IP_i is called a control strategy (Sg_i). A strategy Sg_i is characterized by its intensivity IP_i and value of change in SO_i which are represented in TM_i under the influence of each IP_i flow. Parameters which characterize Sg_i will be examined in connection with SO_i, because the strategy is applied to social objects. In doing so we will also assume these parameters are represented in the corresponding TM_i, so in the corresponding relations for these parameters SO_i will not change, but TM_i or separate fragments of descriptions $tm_i \in TM_i$ will change. Strategy implementation is closely related to the goal of the corresponding influences IP_i. The goal $C_i(IP_i)$ is an integral part of any random IP_i. Strategy $Sg_i(TM_i)$ defines that Sg_i is oriented towards implementing the transformation to TM_i and is intended for reaching a certain goal $C_i(TM_i)$. Because $Sg_i(TM_i) = \{IP_{i1}*\ldots*IP_{ik}\}$, $C_i(TM_i)$ has to be distributed among all IP_{ij}. The corresponding components of the goal C_i, $c_i(tm_i) \in C_i(TM_i)$ are coordinated with each other. Observation of a separate $c_i(tm_i)$ while IP_{ij} influences TM_i in the model scope is performed by changing the fragment $tm_i \in TM_i$. Such change is defined by the number of words changed in tm_i under the influence $c_i(tm_i)$. We will define the following parameters:

Definition 1. Parameter of inertness of a social object $In(SO_i)$ or, respectively, $In(TM_i)$ determines the value of changes taking place in SO_i during implementation $Sg_i(SO_i)$ which falls on one IP_i given $[IP_i \in Sg_i(SO_i)]\&(j > 1])$.

We can assume that $In(SO_i)$ defines the change speed in SO_i during an influence on an object $Sg_i(SO_i)$. The bigger the IP_i needed to implement reaching the goal $C_i(SO_i)$, the bigger the value of $In(SO_i)$. Let us assume $C_i(SO_i)$ is formed depending on requirements that are external to SO_i. This allows relation of the quantity of IP_i to $Sg_i(SO_i)$ and $C_i(SO_i)$. This parameter is formally described by the following:

$$In(SO_i) \propto In(TM_i) = \sum_{i=1}^{m} \varphi_i [j(C_i)] - \sum_{i}^{k} \varphi_k [j(tm_i^a)] \tag{3}$$

Here, φ_i are phrases in the text interpretation of the goal, φ_k are phrases changed in TM_i as a result of IP_i's influence on SO_i.

Definition 2. The suitability of performing the transformations, which will be written as $Dn(SO_i)$ or $Dn(TM_i)$, is the value of the number of changes necessary to implement in TM_i and, respectively, in SO_i with the help of Sg_i, corresponding to the transformation goal $C_i(SO_i)$ or $C_i(TM_i)$, measured by the number of the changed phrases in TM_i.

This parameter is formally described by the following:

$$Dn(SO_i) \propto Dn(TM_i) = F^D[(tm_i \in TM_i) * C_i(IP_i)] \tag{4}$$

Here, F^D is a function which describes a method of comparing $C_i(IP_i)$ with $tm_i^a \in TM_i$. In the most simple case this function can describe a way to calculate disparity in the phrase number with $C_i(IP_i)$ and tm_i^a. The difference between $In(TM_i)$ and $Dn(TM_i)$ is that $In(TM_i)$ is defined using tm_i^a obtained as a result of transformations tm_i under the influence of IP_i, while $Dn(TM_i)$ is defined using tm_i which has not yet been transformed. Using equivalence sign between $In(SO_i)$ and $In(TM_i)$ as well as between $Dn(SO_i)$ and $Dn(TM_i)$ is based on using feedback tools during the implementation of $Sg_i(SO_i)$. This makes it possible to correct changes in TM_i which occurred under the influence of IP_i while modeling the influence of IP_i on SO_i with the help of TM_i, on the basis of feedback data received from SO_i after the IP_i's influence on SO_i.

An important parameter of $Sg_i(SO_i)$ is the implementation time for this strategy ΔT_i. This time is used to describe the properties of SO_i related to characteristics $Sg_i(SO_i)$. It is reasonable to use a representation of functioning stability of SO_i which will be written as $St(SO_i)$. We can assume that stability $St(SO_i)$ is related to the parameter $Dn(SO_i)$. In many cases the value of $St(SO_i)$ is closely related to the parameters characterizing $Sg_i(SO_i)$. One of these parameters could be a number of IP_i used in $Sg_i(SO_i)$. The connection between $St(SO_i)$ and $Dn(SO_i)$ lies in the fact that stationary SO_i in most cases are either not suitable to be modified or require high-efficiency strategies. So let us introduce a definition of strategy efficiency.

Definition 3. Efficiency of a strategy $Sg_i(SO_i)$ is defined by number of IP_i used by $Sg_i(SO_i)$: $E[Sg_i(SO_i)] = \Sigma^n_{i=1} IP_i$, given that each IP_i is optimal.

Parameters of a system of social object control

Controlling SO_i with the help of a system of social object control (*USO*) is performed using data about separate SO_i or a system SSO_i. Thus, it is necessary to define the parameters of SO_i which in this case are necessary to use and determine the interpretation of their possible values. These parameters are as follows:

- inertness of SO_i, ($In(SO_i)$);
- transformation acceptability ($Dn(SO_i)$);
- functioning progressiveness of SO_i ($Pr(SO_i)$);
- development progressiveness of SO_i ($Rp(SO_i)$);
- stability of SO_i ($St(SO_i)$).

All of the mentioned parameters characterize SO_i, so they can be added on to the corresponding TM_i as well. Parameters *In* and *Dn* have already been analyzed. Now we will examine the parameter $Pr(SO_i)$ in detail. Let us assume that progressive development $Pr(SO_i)$ takes place in the case when changes in SO_i have an evolutionary nature. It is known that any SO_i functions, not only when SO_i is activated by information flows IP_i, but also when SO_i implements a solution to the tasks which represent the existence goal of the corresponding SO_i. Thus, values of the SO_i parameters stated above can change regardless of whether some IP_i influence the SO_i or not. To choose a criterion of evolutionary functioning of each $SO_i \in SSO_i$, some common parameter for all SO_i is chosen which directly characterizes not only SO_i but every individual in all SO_i, and this parameter will be called *Ep*. An acceptable change value of this parameter, as well as acceptable ways of changing, have to be set. For example, the value *Ep* can increase, decrease, or change within certain time intervals or according to a certain function. Based on the chosen postulates in the *USO* system, the acceptable values of the following parameters are set:

- threshold of development progressiveness of SO_i, or (ΔRp);
- threshold of acceptable change of functioning progressiveness (ΔPr);
- acceptable threshold of instability degree (ΔSt).

Thanks to the use of social networks by the *USO* system as sources of data about the current SO_i state, it is possible not only to estimate changes of the current SO_i state as a result of an influence of IP_i on the SO_i, but also to estimate changes in SO_i which occur during its natural functioning. This possibility represents an automated process of *SSO* monitoring.

In general, it is possible to monitor SO_i and *SSO* therefore, it is also possible to determine if the occurring changes are within ΔRp and ΔSt.

The difference between ΔRp and ΔPr is that ΔRp is used to analyze changes that occurred as a result of some IP_i influence on SO_i, while ΔPr is used to check the processes of the natural functioning of SO_i.

The abovementioned parameters are connected with each other. Let us examine the connection between $\Delta St(SO_i)$ parameter and $Pr(SO_i)$ with $Rp(SO_i)$. In the *USO* system an acceptable value of change of evolutionary parameter ΔEp is defined. This means that the value of ΔEp cannot exceed the set limit of ΔEp. The value of *Ep* parameter is changed under the influence of *Rp* or *Pr*. *Pr* parameter describes factors which lead to the change of *Ep*. The functioning process of SO_i corresponding to TM_i consists of transformations of text fragments from TM_i. Because there are no external factors such as IP_i in the case of *Pr*, the modification in TM_i is performed based on the usage of data that are received through feedback channels and say that changes have occurred in the corresponding SO_i. This data serves as the basis to form IP_i which are transferred to the corresponding TM_i. Such IP_i will be called internal (IP_i^V), as opposed to IP_i generated to perform control of SO_i. The difference between IP_i and IP_i^V is that there is always a goal of recommended transformations in IP_i, and during these transformations the goal $C_i(IP_i)$ is not always reached to the full extent.

Another difference between IP_i and IP_i^V is that transformation in TM_i on the basis of IP_i, is performed considering the changes in semantic parameters of TM_i. The transformation process of TM_i based on IP_i considers the changes of values of semantic parameters in the modified TM_i. This modification of TM_i under the influence of IP_i is formally described in this way:

$$F(IP_i, TM_i) = \left[(IP_i * TM_i) \rightarrow TM_i^*(\sigma_1, \cdots, \sigma_n)\right] \quad (5)$$

TM_i modification based on the influence of IP_i^V on the model is performed regardless of new values of semantic parameters, and thus goes to the full extent specified by the content of IP_i^V (Durnyak & Sabat, 2010; Volf, 2002). This can be formally written this way:

$$F(IP_i^V, TM_i) = \left[(IP_i^V * TM_i) \rightarrow TM_i^{*V}\right] \quad (6)$$

An important difference between IP_i and IP_i^V is the absence of transformation goal in IP_i^V. This difference appears because IP_i^V states the changes already made in the corresponding SO_i, which occurred in this object. Thus, $Pr(SO_i)$ or $Pr(TM_i)$ parameter defines the change values of semantic parameters which appeared in TM_i^{*V}. Obviously, there is a chance that no such changes occurred and then $TM_i^{*V} = 0$. If such changes do exist, then $Pr(TM_i)$ describes their value for all σ_i, for all modified fragments in TM_i^{*V}.

Modification of TM_i under the influence of IP_i represents the process of controlling the SO_i which occurs when IP_i is influencing the SO_i.

The stability parameter $St(SO_i)$ represents acceptability of change values of semantic parameters during the influence of a sequence of acting IP_i, implemented by strategy $Sg_i(SO_i)$. In the case of IP_i^V influencing on a TM_i, $St(TM_i)$ parameter represents changes of semantic parameters during at least two IP_i^V. In a sense, $St(SO_i)$ parameter represents the change speed σ_i in TM_i during the influence of a series of TM_i or IP_i^V.

Conclusions

This work deals with problems of creation of social object control systems. A structure of a control system is developed, which consists of the monitoring system and text model system which was used to create a tool for modeling separate social objects and social environment in general. In order to perform control operations, information flows are used. These are text descriptions of information that is supposed to have an influence on individuals forming a social object, as well as on the social object as a whole.

In order to analyze how the information flow (IP_i) influences the social object (SO_i) and how effective such influence is, text models (TM_i) are used, which describe the corresponding social objects. To implement an analysis of IP_i's influence on SO_i, the information flow is transformed into normalized form and is transferred to the corresponding TM_i. Fusion of TM_i and IP_i consists of partial or full supplement of TM_i with data contained in IP_i. The fusion process between TM_i and IP_i is interpreted by processes of changes occurring in SO_i under the influence of IP_i.

Besides text models and information flows, a system is developed to monitor the information sources from separate individuals which form SO_i, as well as SO_i as a whole. The information sources are social networks that are quite popular among many segments of the population. A conception of implementation strategy of social objects global control is developed.

To perform a quantitative analysis of the fusion results of TM_i and IP_i, the use of semantic parameters is proposed. Estimation methods of these parameters are proposed. The work contains description of interpretation of semantic parameters in SO_i. A method is developed for the global organization of functioning process of SO_i control system.

The conceptions of TM_i developed in the work are new, not only in the branch of social achievements, but also in the theory of automated control.

The conception of TM_i relation to semantic parameters from SO_i is also developed and researched for the first time.

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