

**УДК:** 004.94, 316.62

**Title:** Semantic model for collective cognitive and behavioral dynamics

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### **Introduction**

Social security challenges including commercial, political and cultural sentiment regulation motivate massive effort in modelling of collective behavior. However, most of the existing models of social behavior fail to account for cognitive behavioral factors which become central in the present information age [1,2]. Attempts to address this issue even include physics-based models where cognitive system of actors is emulated by quantum states interacting with electromagnetic radiation representing information field [3]. Though conceptually attractive, at present this approach lacks clear correspondence between physical and social quantities which impedes its practical use.

### **Objective**

In this work we aim to establish a realistic approach to model a group of individuals interacting with information field. We develop a numeric algorithm modelling collective opinion about modules of information field as well as internal evolution of cognitive states of individuals.

### **Base research positions**

In our model individual cognitive states as well as modules of external information are represented by texts in natural language. Their interaction is modelled by modifying corresponding texts dependent on the semantic affinity between information module and individual's cognitive state. Analysis of texts is outsourced to specialized software solutions which represent them as vectors in multidimensional semantic space [4,5]. This vector representation of decision making algorithms of cognitive systems and content of information modules is subsequently used for evaluation the above semantic affinity.

The modelling procedure is iterative. At each step individuals evaluate documents in their semantic neighborhood by comparing corresponding vectors with their cognitive state vector. Similarity is measured by the value of scalar product. In case this value exceeds a certain threshold the document receives an «interesting» rating and is allowed to change cognitive state of an individual, making it closer to this document-vector. This corresponds to a situation when a person recognized the information module and changed his cognitive state accordingly. Otherwise, individual ignores the text and proceeds to the next step unchanged. Interaction between individuals is modelled by supplementing external information modules with indicator of popularity which is taken into account along with individual relevance at the evaluation stage.

### **Intermediate results**

1. A web algorithm for automated retrieval of natural language texts representing the information field is developed;
2. A model for semantic interaction of individuals with external information modules is developed;
3. Two approaches to text semantic analysis are assessed, namely Latent Semantic Analysis [4] and BigARTM topic modelling system [5]. The last one has demonstrated better results and is in priority now.

The fundamental principles of the proposed approach to social modelling are (i) dependence of the individual behaviors on the internal cognitive states and (ii) variability of these internal states under influence of external interactions. In these respects, our model is conceptual successor of the quantum inspired socio-physical approach mentioned in the introduction, general effectiveness of which is now established [6,7]. At the same time, it avoids its weak sides and therefore has potential to quantitatively model collective psychic and behavioral phenomena.

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