TECHNICAL SCIENCES

DECISION SYSTEM BASED ON BEHAVIOR MODELS

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Abstract

This paper addresses to specific issues of Multi-Agent systems for decision-making in complex processes. At the base of the Multi-Agent system is the notion of behavior that integrates the knowledge, strategies and target objectives of the Agent. The knowledge and strategies applied by the Agents present a dynamic process that is updated in time respecting the target objectives and the parametric restrictions of the complex process.

Keywords: Multi-Agent systems, collective decision-making, complex problems, behavior model, target objectives, optimal solutions.

Today, Multi-Agent systems present the most acceptable model for solving complex problems based on the concept of collective decision-making [1,5,7]. From the point of view of the field of application, Multi-Agent models are of interest for such sectors as: marketing, economic and strategic management, logistics, and economic, social and political relations [2]. All these sectors of the economy can be considered as dynamic and complex models based on partnerships, coalition, competition and conflicts in which the decisive role is played by the humans [3].

The presence of the human factor in collective decisions can lead to significant financial losses because the correctness of some decisions can be influenced by the emotional state or physiological fatigue of the person. In order to exclude this disadvantage, the human presence as a decision-maker is excluded, but maintaining their behavioral abilities by applying behavioral models based on knowledge, strategy and purpose (Artificial Intelligence models) [4].

A decision-making system based on behavior models presents a $\boldsymbol{N}$ set of Agents $\boldsymbol{A}=\left\{\boldsymbol{A}_i, \boldsymbol{i}=\overline{1,\boldsymbol{N}}\right\}$ which acts collaboratively in order to solve a complex common $\boldsymbol{CP}$ problem. Each Agent is defined by a behavior model that identifies it in the set of Agents and assigns it some rights and obligations in solving that problem [5].

Let the complex problem be defined by the model (1):

$$\boldsymbol{CP}=\begin{cases} \boldsymbol{f}\left(\boldsymbol{x}(\boldsymbol{t})\right)-\boldsymbol{g}\left(\boldsymbol{x}(\boldsymbol{t})\right)\rightarrow \max\limits_{\boldsymbol{x}(\boldsymbol{t})\in \boldsymbol{X}}, \\ \boldsymbol{X}=\left\{\boldsymbol{x}(\boldsymbol{t})\middle|\varphi_j\left(\boldsymbol{x}(\boldsymbol{t})\right)\le 0, \forall \boldsymbol{j}=\overline{1,\boldsymbol{M}}\right\}. \end{cases} \quad (1)$$

where: $\boldsymbol{f}\left(\boldsymbol{x}(\boldsymbol{t})\right)$ are the planned actions of the Agents $\boldsymbol{A}$ in solving the problem $\boldsymbol{CP}$; $\boldsymbol{g}\left(\boldsymbol{x}(\boldsymbol{t})\right)$ are the actions applied by competitors in order to destabilize the solution of the $\boldsymbol{CP}$ problem; $\max\limits_{\boldsymbol{x}(\boldsymbol{t})\in \boldsymbol{X}}$ are the target objectives of the activities of Agents $\boldsymbol{A}$ obtained as a result of solving $\boldsymbol{CP}$ problem; $\boldsymbol{X}$ is the validity space of $\boldsymbol{CP}$ problem.

The behavior model of an Agent is defined by the expression (2):

$$\boldsymbol{A}_i=\left\{\boldsymbol{K}_i\cup \boldsymbol{S}_i\cup \boldsymbol{G}_i\right\}, \quad (2)$$

where: $\boldsymbol{K_i}$ is the available knowledge, $\boldsymbol{S_i}$ - are the applied strategies and $\boldsymbol{G_i}$ - are the target objectives of the Agent $\boldsymbol{A_i}$ for solving the $\boldsymbol{CP}$ problem.

The knowledges $\boldsymbol{K_i}$ of an Agent is defined by the model (3):

$$\boldsymbol{K}_i(\boldsymbol{t})\xrightarrow{K_i(t):(f(x(t)),g(x(t)))}\boldsymbol{K}_i(\boldsymbol{t}+1), \quad (3)$$

where: $\boldsymbol{K}_i(\boldsymbol{t}):\left(\boldsymbol{f}\left(\boldsymbol{x}(\boldsymbol{t})\right),\boldsymbol{g}\left(\boldsymbol{x}(\boldsymbol{t})\right)\right)$ determines the dynamics of knowledge that is obtained at each decision-making step $\boldsymbol{t}$ based on existing knowledge $\boldsymbol{K}_i(\boldsymbol{t})$ and of actions $\boldsymbol{f}(\boldsymbol{x}(\boldsymbol{t}))$ and $\boldsymbol{g}(\boldsymbol{x}(\boldsymbol{t}))$ planned for Agents [6,7].

The strategies $\boldsymbol{S}_i$ applied to the Agent are defined by the model (4):

$$\boldsymbol{S}_i(\boldsymbol{t})\xrightarrow{K_i(t):(f(x(t)))}\boldsymbol{S}_i(\boldsymbol{t}+1), \quad (4)$$

where: $\boldsymbol{K}_i(\boldsymbol{t}):\left(\boldsymbol{f}\left(\boldsymbol{x}(\boldsymbol{t})\right)\right)$ determines the dynamics of the strategies applied by the Agent which are calculated on the basis of current knowledge $K_i(t)$ and of the planned actions $f(x(t))$.

As an example, can be examined the application of the decision-making system based on behavioral models for the field of furniture production.

Let be defined the CP problem, which specifies the activity of a furniture company. A set of Agents $A = \{A_i, i = \overline{1, N}\}$ are used for production management process, as well as for the logistics and marketing process.

The activity of each Agent is regulated by model CP (1), where: $f(x(t))$ defines the technological process for production, logistics and marketing; $\max\limits_{x(t)\in X}$ presents the target objectives for obtaining a maximum profit as a result of economic activity; X are the restrictions related to financial resources, labor, production spaces, technological insurance, etc.; $g(x(t))$ represents the presence of competitors who deliver the same products on the market.

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USING STATISTICAL TEXT PARAMETERS TO DETERMINE AUTHOR'S SCIENTIFIC DOCUMENTS WRITTEN STYLE

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Abstract

The rapid growth of information volume in the world is contributing to the appearance of new information and linguistic tasks related to word processing. One of such tasks is to determine the author's style of writing. The article investigates the use of statistical features of the text to identify the author's style of scientific texts in Russian. Based on a set of statistical features by using machine learning methods from a certain set of applicants, a potential author of the text is determined. The quality of the classification is assessed using F-Measure. As a result of experiments the F-Measure value is received from 0,219 to 0,799. The following stages of the research are aimed at improving the accuracy of classification to determine the potential author of the text.

Keywords: Authorship Identification, Writing Style, Statistical Properties of Text, Machine-learning methods.

Introduction

The task of defining the author's style is not a new task. The first attempts to identify the author's writing style were made in the 19th century [1]. Scientists around the world continued research on the topic. At the present stage, a foundation has emerged that has brought the investigation of the writing style to a qualitatively new level. This is the rapid development of information technology for information searching, machine learning, and natural language processing, some of them:

– effective methods for presentation and classification of large texts have been developed;