

A new approach to the analysis proximity between the political positions of group participants

Elena Kornilina, Aleksandr Mikhailov
 Keldysh Institute of Applied Mathematics Russian Academy of Science
 Moscow, Russia
ekornilina@gmail.com, ekornilina@yandex.ru

The study focuses on mathematical modeling proximity dynamics of positions of interacting individuals. The alternative method measuring the proximity of declared in texts political positions is suggested and tested on the example of pre-election programs of parties in Russian assembly (the State Duma) and social nets users' records. The method could be used to fulfill the model with data and to validate its quality.

Keywords-mathematical modeling, political positions, social nets, pre-election programs

I. INTRODUCTION

The mathematical models describing the human relations have been developed for a long time (e.g., [1],[2]). The main idea in their basis could be described as follows. There're affective relations between every two participants, not necessarily symmetric. These relations may change over time and could be described with numerical functions of time. The corresponding function value is positive if the first individual has positive relations with the second etc. During interactions, the individuals share opinions about other participants of the group, that cause a dynamic of relations in the group. At the same, there're general principals laid in the model, like "if a person whom I dislike, speaks ill of the third person, then I improve my opinion of that third person" etc. Here we also consider the group relations, under the assumption that the individuals share their opinions about political questions, not about other individuals, and the communications are mass, not pairwise.

II. MODEL DESCRIPTION

A mathematical model is suggested for the proximity dynamics of positions of interacting individuals, which form a closed group of collaborators. We consider the group of K collaborating individuals discussing N questions, which can lead the changing of their positions. The individual opinions are simultaneously shared with other participants (mass communications), which is common for forums, Internet communities etc. This is new to the classic group dynamics theory, which traditionally models the relations only and they're pairwise (e.g., [1],[2]). The proposed model is described as a system of ordinary differential equations and gives the correlation between positions and relations dynamics.

$$\frac{dx_{ij}}{dt} = \gamma_i x_{ij} \sum_{n=1}^N \alpha_{in} \left[(z_{in} - z_{jn})^2 - a^2 \right] \quad (1)$$

$$\frac{dz_{in}}{dt} = \sigma_i \sum_{j=1}^K \beta_{ijn} \left[(z_{jn} - z_{in}) - (R_i - x_{ij}) \right] \quad (2)$$

$$x_{ij}(0) = x_{ij}^0, \quad z_{ij}(0) = z_{ij}^0 \quad (3)$$

Here we suppose that $x_{ij}(t) \geq 0$ characterizes the subjective distance between i -th and j -th individuals, $z_{in}(t) \in (-\infty, +\infty)$ – the position of i -th individual on the n -th question at some time t .

The positions on n -th questions at some time t are so close that the relations get better, if $|z_{in}(t) - z_{jn}(t)| < a$, where a is a specified parameter. The parameter α_{in} describes the subjective importance of n -th question for the i -th individual, such that $\sum_{n=1}^N \alpha_{in} = 1$ and the parameter $\gamma_i > 0$ characterizes the individual rapidity to change relations to others. The $\sigma_i > 0$ parameter characterizes the individual rapidity to change position on discussed questions and $R_i > 0$ characterizes the individual distance for others to consider them as opponents. The impact to position of i -th individual on the n -th question from others are summarized with the coefficients

$$\beta_{ijn}, \text{ normalized so that } \sum_{j=1}^K \beta_{ijn} = 1.$$

Thereby, the system of model equations of political positions dynamic is presented in (1),(2) with the initial conditions (3), where i, j take values from 1 to K , n takes values from 1 to N (see details in [3]).

The results of numerical experiments for the system are held and a number of substantial conclusions are formulated for the steady states in case of 2 discussed questions and unlimited number of individuals. It is shown that generally, the zero steady state (the agreement state) is asymptotically stable and the area of the initial values for that steady state is obtained.

III. VARIABLES MEASUREMENT

The two basic variables for the system are: the relations between individuals $x_{ij}(t)$ and their positions on discussed questions $z_{in}(t)$. We consider that $x_{ij}(t)$ can be measured somehow with one of the psychological or sociometrical method, which have been developed since the 19th century. Here we consider $z_{in}(t)$ to be the expressed in text political positions of individuals (for example, pre-election programs, political blogs etc.). And as it is shown in the system, we use only the difference between positions (positions' proximity), not the absolute value. Traditionally, the positions' proximity is measured with content analysis that requires expert evaluation. We present another way of measuring, which is implemented in an independent algorithm (see [4]). The main idea that we suggest is that the positions' proximity could be interpreted as the syntagmatic proximity of texts (see [5]). The syntagmatic way of measuring text distances is the understanding word's meaning by its content in which it is used. The approach was implemented in latent semantic analysis (see details in [6]).

The method was tested on the pre-election programs of parties in Russian assembly (the State Duma) in the 2007th and the 2011th years. The comparison is shown for four parties: Edinaja Rossija, KPRF, LDPR and Jabloko. Three of them are traditionally represented in Russian assembly, and the Jabloko party was also included in the list, because it has the reputation of "most unlikeable" to others. Note that the method has no limits for the text quantity, so programs of other parties (not only four described above) could be examined too.

For these four parties we got a table of pairwise distances from the point of cognitive distances. The Fig.1 shows the hierarchical clustering of parties made on the table of distances data.

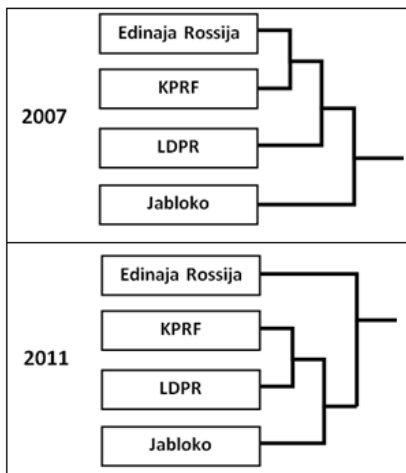


Figure 1. The distances between parties in the 2007th and the 2011th years

Here we can see that during the Election campaign 2007, Edinaja Rossija and KPRF programs were the most closest and the most distant from others was Jabloko's program. Some changes have been made during the Election campaign 2011: KPRF and LDPR programs were the most closest and the most distant from others was Edinaja Rossija program.

As you see, these results are only for two time-periods in the system (1)-(3). Further work with more experiments is planned.

Also, several experiments on popular political blogs (in Livejournal and online versions of well-known political magazines) have been conducted. These experiments confirmed that the proposed method provides a good evaluation of the similarity of political positions stated in the texts. It was also shown that the more stylistically similar results are presented to the algorithm, the more precise estimations it provides.

IV. CONCLUSION

A mathematical model of the proximity dynamics of positions of interacting individuals, which form a closed group of collaborators is suggested. Numerical and analytical study of steady states in case of 2 discussed questions and unlimited number of individuals is conducted.

A method of measuring the proximity of political positions stated in texts is proposed, the method helps to generate empirical data for saturation of model. The applicability of method is demonstrated on the example of political communities in Internet and also the dynamic of pre-election programs of political parties in 2007 and 2011 is observed.

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