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Estimating probable electoral losses using gaming approach in the conditions of information countermeasures

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Abstract
The task of assessing the destructive effects on information is considered public safety on the example of electoral losses in the process of information opposition. To find a solution to the above problem, it is proposed a non-linear model based on process modeling pre-election races. Based on similar studies, it was the impact of destructive informational influences on certain security is considered layers of society. A case study where an adversary advances its narratives for capture of a part of society in its information field, as well as his keeping under its influence at the expense of existing agents. For this purpose he involves influence agents who act in two groups. For the specified situation it was the process of transition of the electorate to the information environment is simulated opponent.

The following groups of objects were considered in the model: our agents, which functionally, they only oppose the agents of the adversary, groups of society, divided according to the possible impact on them, and two groups of agents enemy, each of which can change as a result of losses and necessity keeping under its influence members of the social groups that reacted positively on the information narratives of the adversary. As a result, the simulation was carried out assessment of probable electoral losses, which provides grounds for determination optimal counteraction to destructive informational influences.

Keywords: public safety, information influence, game approach, agents of influence, electorate

Introduction

Among the recent events in the modern world, a trend can be traced to the greater use of cyberspace and information influence for achieving their goals. The role of these spheres of activity is increasing every year of significant weight, when making decisions in various societies. There are many examples that clearly testify to the pressure of some states on others at the expense of others' impact on their information agendas. There are not rare cases when certain mass media,

Internet communities, media personalities, etc. spread misinformation with the aim of influencing certain processes of one country in the interests of another. From here on the first priority is the search for means of informational struggle, and implementation of a competent policy in the field of information security.

It is quite logical, that at the current rate of development of digital communications, such a sphere of activity, acquires critical importance in terms of ensuring security as political processes within the country. Based on this kind of reasoning, should note that politics and cyberspace are becoming increasingly linked between themselves, which fact is evidenced by the increasing use of such technologies, such as the creation of information spillovers, aggravation of information reasons, etc. From here comes the idea of modelling the processes, that take place with the use of cyberspace, based, for example, on election races [1-3].

It should be noted that global information security of the country, forecasting its stability in relation to destructive influences are urgent issues of today. It is obvious that these processes are correlated with such social phenomena as political elections. Therefore, the use of models that are used to simulate the above processes is fully justified.

It is worth noting that in the process of pre-election races, a task arises to counteract the information influences of the adversary. With the specified problem every headquarters of political forces often encounters. Definitely there is a rich the number of methods developed and proven by practical activities that in that or otherwise solve these tasks.

One of the approaches to the solution is an attempt to put yourself in place. The enemy and analyze his side of his action. Moreover, to us better known by their way of action and understanding the shortcomings we can assume. This approach was considered, for example, at work [4]. The authors proposed to continue this work and apply the specified approach. By the authors it is proposed to continue this work and apply the specified approach.

In contrast to the work [4], where the agents were immediately divided into a group, with the maximum possible influence on a member of society, here agents the opponent is represented by two groups, one of which has the maximum impact, and the other has a fairly average level of an impact compared to the first. Let's move on to considering the formulation of the problem and describe the transformation processes enemy groups.

1. The theoretical part

Consider a group of people who are a target audience for the agent's opponent. Distribute them by the level of influence and, in addition, introduce the set of our agents. Let us denote these sets as follows

$N = N_1 + N_2 + N_3 + N_4 + N_5,$

where

N_1 is the set of our agents.

N_2 is the set of people exposed to the two agents.

N_3 is the set of people exposed to the three agents.

N_4 is the set of people exposed to the four agents.

N_5 is the set of people exposed to the five agents.

We will also mark those who were affected Z.

Consider the structure of the set of adversary agents V. At the initial stage, it consists of groups of threes and fives, i.e $V = 3V_3 + 5V_5$, where

$_3$is number of threes,

$V_5$is number of fives.

The task of the agents of the opposite party is to persuade the electorate in your information field. To this end, it launches its influence groups divided into threes and fives.

At the same time, we believe that there are many people Z must be left under your control. For this, the opponent leaves one agent, which becomes inactive, per four persons from the set *Z*.

In initial moment of time t=0 $N_i(0) > 0, i = \overline{1,5}, V_3(0) > 0, V_5(0) > 0, V_1(0) = 0, V_2(0) = 0, Z(0) = 0.$ Next, with point of view of the opponent, the whole process is divided into two stages.

At the first stage, only the majority of V_3 directs its members to the maintenance of representatives from group Z involved in it with the help of V_3 and V_5.

At the same time, triples are transformed into twos, that is, the set V_3 turns into the set V_2. In turn, the representatives of the V_2 set also leave their members for maintenance in their information field of the electorate from the set Z, but only those whom they themselves influenced. In this case, the twos are transformed into agents of ones, that is, the set V_2 goes to the set V_1.

After that, the transformation of the set V_5 takes place, namely, the member of the set V1 joins the five and it is divided into two threes. That is, taking one element each from the set V_5 and V_1, we get two elements of the set V_3 . It should be noted that V_2, V_3 and V_5 lose their agents when meeting with representatives of N_1, take them out of the game, while also losing their members.

$$\begin{cases} N_1^{t+1} = N_1^t - \left(\frac{N_1^t}{N}\right)(V_2^t + V_3^t + V_5^t) \\ N_2^{t+1} = N_2^t - \left(\frac{N_2^t}{N}\right)(V_2^t + V_3^t + V_5^t) \\ N_3^{t+1} = N_3^t - \left(\frac{N_3^t}{N}\right)(V_3^t + V_5^t) \\ N_4^{t+1} = N_4^t - \left(\frac{N_4^t}{N} \cdot V_5^t\right) \\ N_5^{t+1} = N_5^t - \left(\frac{N_5^t}{N} \cdot V_5^t\right) \\ V_1^{t+1} = \left(\frac{N_2^t}{N} \cdot V_2^t\right) mod4 \\ V_2^{t+1} = V_2^t - V_2^t \frac{N_1^t}{N} - \left(\frac{N_2^t}{N} V_2^t\right) mod4 + \\ + \left(\left(\frac{N_2^t + N_3^t}{N}\right) V_3^t + \left(\frac{N_2^t + N_3^t + N_3^t + N_3^t}{N}\right) V_5^t\right) mod4 \\ V_3^{t+1} = V_3^t - V_3^t \cdot \frac{N_1^t}{N} + +2V_1^t \\ - \left(\left(\frac{N_2^t}{N} + \frac{N_3^t}{N} + \frac{N_4^t}{N} + \frac{N_5^t}{N}\right) \cdot V_5^t + \left(\frac{N_2^t}{N} + \frac{N_3^t}{N}\right) \cdot V_3^t\right) mod4 \\ V_5^{t+1} = V_5^t - V_5^t \frac{N_1^t}{N} - V_1 \\ Z^{t+1} = \frac{N_2^{t+1}}{N}\left(V_2^{t+1} + V_3^{t+1} + V_5^{t+1}\right) + \\ + \frac{N_3^{t+1}}{N}\left(V_3^{t+1} + V_5^{t+1}\right) \\ + \left(\frac{N_4^{t+1} + N_5^{t+1}}{N} \cdot V_5^{t+1}\right) + Z^t \end{cases} \quad (1)$$

Where, $\frac{N_i^t}{N}$ is the probability of meeting a representative of the N_i^t, i =1,..,5 at a moment in time t;

$\frac{N_i^t}{N} V_j^t$ is number of representatives N_i^t, which came under the influence of agentsV_j^t at the moment time t, i =2,..,5, j =2,3,5.

$\frac{N_1^t}{N} V_j^t$ is number of enemy agents which neutralized by our agents, j=2,3,4.

$\left(\frac{N_2^t}{N} V_2^t\right) mod4$ is the number of elements of the set V_2^t, that moved to V_1^t.

$\left(\left(\frac{N_2^t}{N} + \frac{N_3^t}{N}\right) \cdot V_3^t\right) mod4$ and $\left(\left(\frac{N_2^t}{N} + \frac{N_3^t}{N} + \frac{N_4^t}{N} + \frac{N_5^t}{N}\right) \cdot V_5^t\right) mod4$ is the number of elements of the set V_3^t, that moved to V_2^t. From the set V_5^t subtracted V_1^t, and to V_3^t is added V_2^t, since one element V_1^t and one element V_5^t create two elements V_3^t.

The second stage occurs when the set $V_5 = \emptyset$. In this case, members N_4 and N_5 will no longer be affected and the formation of the set V_3 is performed at the expense of one element of V_1 and one element from V_2. At the end, we note that under the most favorable conditions for the opponent, Z = 4V .

Those who have not been influenced by any of the groups do not accept any of the sides.Let the moment of time T_1come, such that

$$V_5(T_1) = 0 \quad (2)$$

Then from condition (2) we have the following conditions

$$\begin{matrix} N_5(T_1) = const \\ N_4(T_1) = const \end{matrix} \quad (3)$$

Using (2) and (3), the original system of equations (1) will take the following form

$$\begin{cases} N_1^{t+1} = N_1^t - \left(\frac{N_1^t}{N}\right)(V_2 + V_3) \\ N_2^{t+1} = N_2^t - \left(\frac{N_2^t}{N}\right)(V_2 + V_3) \\ N_3^{t+1} = N_3^t - \left(\frac{N_3^t}{N} \cdot V_3^t\right) \\ V_1^{t+1} = \left(\frac{N_2^t}{N} \cdot V_2^t\right) mod4 \\ V_2^{t+1} = V_2^t - V_2^t \cdot \frac{N_1^t}{N} - \left(\frac{N_2^t}{N} \cdot V_2^t\right) mod4 + \\ + \left(\left(\frac{N_2^t}{N} + \frac{N_3^t}{N}\right) \cdot V_3^t\right) mod4 - V_1^t \\ V_3^{t+1} = V_3^t - V_3^t \cdot \frac{N_1^t}{N} - \left(\left(\frac{N_2^t}{N} + \frac{N_3^t}{N}\right) \cdot V_3^t\right) mod4 \\ Z^{t+1} = \frac{N_2^{t+1}}{N}(V_2^{t+1} + V_3^{t+1}) + \left(\frac{N_3^{t+1}}{N} \cdot V_3^{t+1}\right) + Z^t \end{cases} \quad (4)$$

From the set V_2^t subtracted V_1^t, and to V_3^t is added V_1^t, since one element V_1^t and one element V_2^t create two elements V_3^t.

2. The practical part

Suppose, we have the following input data

$$N_1 = 1800, N_2 = 2000, N_3 = 4000,$$
$$N_4 = 3000, N_5 = 700, V_1 = 0,$$
$$V_2 = 0, V_3 = 1000, V_5 = 200.$$

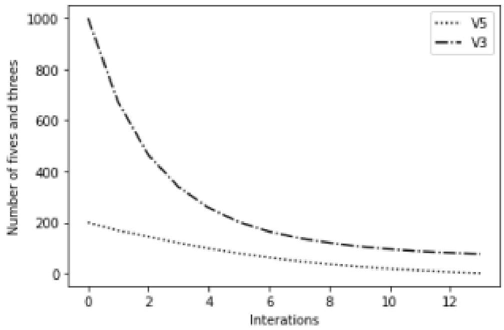

Figure 1

Figure 1 shows graphs of sets V_3 and V_5. As can be seen, from the figure, the set V3 grows rapidly at the beginning due to replenishment from the crowd V_5, and then decreases. In the set V_5there is first a sharp and then a slower decline. Only one conclusion can be drawn here numerical modelling is correct.

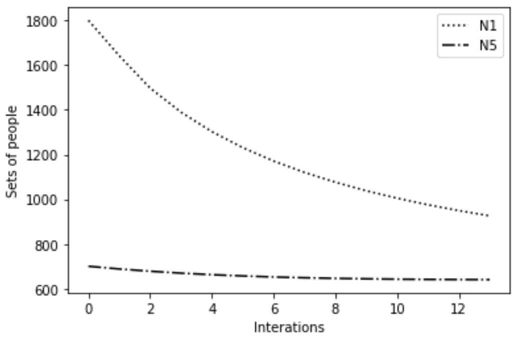

Figure 2

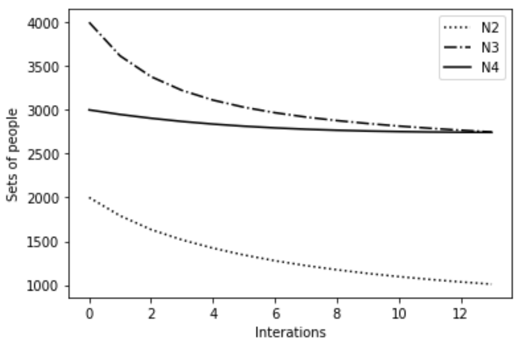

Figure 3

From the graphs in Fig. 2 (N_1, N_5) and Fig. 3 (N_2, N_3, N_4) it can be seen, that set N_2, N_3, N_4 and N_5 have approximately the same nature of decline their values. Hence, it is quite logical to assume that, when increasing efficiency our agents for detecting enemy charts N_1will decline more slowly, and then, in turn, the reduction of sets will slow down N_2, N_2, N_4 and N_5.

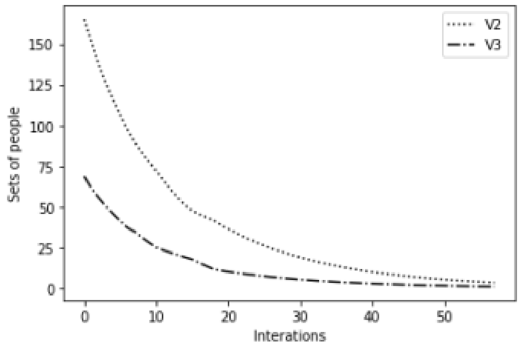

Figure 4

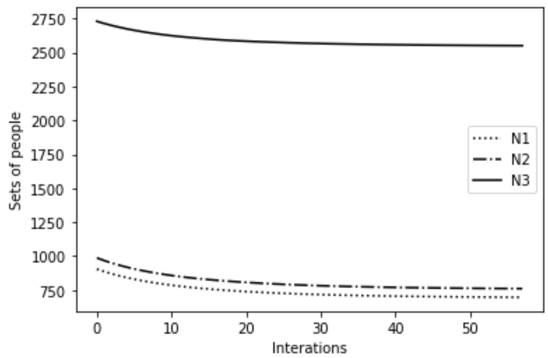

Figure 5

The results of the simulation of the second stage are presented in Fig. 4 (V_2, V_3) and Fig. 5 ($N_1, N_2,\ N_3$). It is obvious that the effectiveness of multiple agents N_1quite low which is explained by the small number of enemy agents $V_2$and V_3after the end of the first stage. This is also reflected in the slight decrease sets $N_2$and N_3.

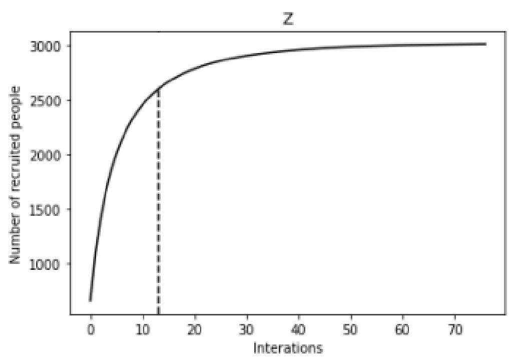

Figure 6

The last figure 6 shows how the set changes Z , which points to the number of people exposed to the influence of the enemy. In Fig. 6, the intersection of the Z graph and the dotted line means the moment when $T_1 = 0.$ In our experiment the maximum Z=3013 It should be noted that under the most favorable conditions for opponent

$$Z = 4V = 4(3V_3 + 5V_5),$$
$$i.e\ Z = 16000.$$

3. Conclusions

In this paper, a model of information influence was developed and investigated by the opposing party to assess probable electoral losses. By models describing pre-election races were taken as a basis and simulated process from the adversary's point of view. During the research, it was assumed that the opposite side began to act with two groups of agents and with different opportunities for information influence.

During the experiment, the indicated groups underwent a certain transformation, such as that decrease or increase in number, as well as transfer to other groups for a certain way of acting. Therefore, the simulation was carried out in two stages. First, the stage ended when the majority V_5 became empty. In the second stage, the equations of the model changed and continued as long as the set V3 also did not become empty.

A computer experiment was conducted to calculate the above stages. Graphs of the dynamics of changes in the number of sets were obtained $N_1, N_2, N_3, N_4, N_5, V_2, V_3, V_5$ and Z. This result was analyzed.

The model was developed and proposed the game approach provides the necessary grounds for improving countermeasures' destructive informational influences and the possibility of their practical application use for solving real problems.

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