ABOUT OPTIMAL CONTROL TASK OF THE FIGHT AGAINST DISINFORMATION

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Abstract. Mathematical and computer model of disinformation is discussed, the dynamic system of false information dissemination and its opposite - objective information is described in the model. A compartmental method is used to build a mathematical and computer model of the spread of false information and its precursors: the society is conditionally divided into groups depending on what kind of information flow the members of the group are under the influence of. Individuals can move from one group to another, and so on, under the influence of false and opposite information flows. The number of individuals in groups, the rate of their change, the migration of individuals between groups are described by mathematical ratios. The number of people under the influence of misinformation in the society, which do not create a critical point in terms of information security, is determined. The task of combating disinformation thus represents the transfer of a dynamic system from the initial state to a state where the number of persons influenced by disinformation does not form a critical mass dangerous for society. The issue of controllability of the dynamic system is discussed. The controllability of the dynamic system is tested by a computer experiment. The task of controllability of the dynamic system, after the introduction of the function in which the "price" of disseminating false information is "weighted", has been transformed into the task of optimal control of the fight against disinformation.

Keywords: *Information warfare, disinformation, mathematical and computer models, the optimal control task of the fight against disinformation.*

Introduction. Disinformation, a constituent part of the information warfare, has become almost universal in recent decades. It is applied by individuals or firms, by states or their unions. Because of this, anti-disinformation measures are increasingly being used by the targets of disinformation. So, for example, the European Union considered that a disinformation campaign against the European Union's neighborhood policy was underway with the instructions of the Kremlin and for its neutralization created a special group "East Strategic Communication" - EastStratCom Task Force, https://euvsdisinfo.eu. The funding of this group has increased tenfold since 2015, and today its budget is 11.1 million Euros. So far, under the auspices of the group, 15,000 cases of disinformation in 15 languages have been reviewed and rebuttals of the corresponding false information have been published [1].

From the action analysis of the "strategic communication with the East" we can conclude that: a) measures against disinformation information flows also include the dissemination of information flows in which disinformation is invalidated; b) The fight against disinformation requires the mobilization of various types of resources (financial, material, human and others) and it is natural that they should be used efficiently, and the goal should also be achieved.

In the presented work, by using mathematical and computer models and the task of managing the fight against disinformation, regularities of changes in the quantitative characteristics of the spread of disinformation and disconfirming information flows and the conditions for effective fight against disinformation are described.

Mathematical and computer models of disinformation dissemination. Let's assume that at any moment of time $t \in [0,T]$, some interested organization in the society for certain purposes spreads a certain amount of $F(t)$ - false information. In addition, there is a second type of organization in society that disseminates a number of $N(t)$ anti-false information to neutralize false information.

As a rule, there are different groups in the society that react differently to the spread of false and contrary information. First of all, let's identify the group of society that is affected by both false and its opposite information - let's call this group **the risk group** - RG and mark the number of members in it at any moment of time t with $R(t)$. The members of the risk group who are under the influence of false information and become its adherents form a separate group, let's call it the adept group - AG and denote the number of members in it by $A(t)$. As a result of spreading information against disinformation, it is possible that some members of the Adept group will separate from the false information and move to another group, in which those

who are immune to falsehood will unite, let us denote **the immunity to falsehood group** by IG and the number of members in this group by $I(t)$. Note that over time some members of the adepts may separate from false information as a result of personal evolution, not because of the spread of counter-disinformation $N(t)$. Thus, society is divided into three groups, and people move between these groups as a result of both information flows and intergroup relations. As a result, we obtained a compartmental basis for the construction of a mathematical and computer model of the false and contrary information spread [2,3,4] - Figure.

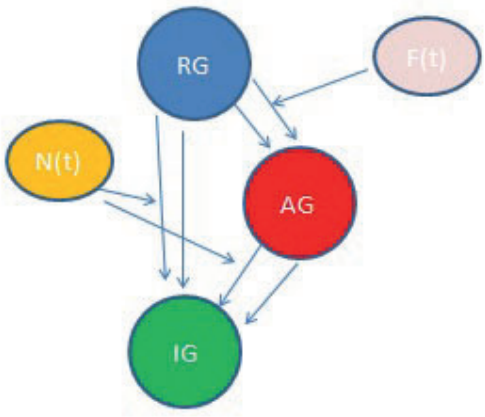

Figure. Scheme of individuals transitioning from one group to another

If we describe the speed of change in the number of groups with mathematical ratios, taking into account migrations between groups, we will get a dynamic system of disinformation spread in society [5]:

$$\begin{cases} \frac{dR(t)}{dt} = -\lambda(t)N(t)R(t) - \kappa(t)F(t)R(t) - \alpha_1(t)R(t)A(t) - \alpha_2(t)R(t)I(t), \\ \frac{dA(t)}{dt} = \alpha_1(t)R(t)A(t) + \kappa(t)F(t)R(t) - \lambda_1(t)N(t)A(t) - \gamma(t)A(t) - \beta_1(t)A(t)I(t), \\ \frac{dI(t)}{dt} = \gamma(t)A(t) + \alpha_2(t)R(t)I(t) + \beta_1(t)A(t)I(t) + \lambda_1(t)N(t)A(t) + \lambda(t)N(t)R(t), \\ \frac{dN(t)}{dt} = \omega_1(t)A(t)\left(1 - N(t)/M_1\right), \\ \frac{dF(t)}{dt} = \omega_2(t)R(t)\left(1 - F(t)/M_2\right). \end{cases} \quad (1)$$

$$\begin{cases} R(0) = R_0 > 0, A(0) = A_0 > 0, I(0) = I_0 \geq 0, \\ N(0) = N_0, \quad F(0) = F_0. \end{cases} \quad (2)$$

where $\omega_1(t)$, $\omega_2(t)$ respectively represent the intensity coefficients of the objective and false information spread. M_1 M_2 - Accordingly, the volumes of technological possibilities of spreading objective and false information.

A model of effective fight against the spread of false information (MEFASFI). The dynamic system (1) with initial conditions (2) describes the spread of false and opposite information in society, their impact on society members. Let's note that collective misinformation, I.e the presence of a significant part of society under the influence of false information, in some cases contains the possibility of changing the vector of society's development. So, for example, in the conditions of collective disinformation, let's say about the parliamentary elections. Extremist political groups could receive more votes than expected, giving them the opportunity to significantly influence the law-making process and the formation of the government. In the leading democratic countries of the West, the data of the winning party in the parliamentary elections varies within 25% of the number of participants in the elections, and the parties with a chance to join the coalition usually get no more than 10% of the votes. If we assume that getting an additional 5-7% for radical parties is a great success, we can assume that the public will make a decision resistant to misinformation if only 5% of voters are misinformed.

Thus, we determined the goal that should be served by the creation and dissemination of information against false information $N(t)$, In particular, to influence the society so that the number of adherents during the parliamentary elections is less than 5% of the total number of the society, If we take into account that the creation and distribution of information is related to financial costs, it is natural that this amount should be minimal. We already have the opportunity to establish a model of effective fight against the spread of false information **(MEFASFI)**

Let's say the price of spreading one unit of objective information at a moment in time $t \in [0,T]$ Is $\phi(t)$. Price for objective information spread over the observation period will be $\int_0^T \phi(t)N(t)dt$. During the observation period, this quantity should be minimal in relation to $\omega_1(t)$ and M_1, that is, the intensity of the dissemination of objective information and the volumes of technological possibilities of dissemination of objective information.

$$J(\phi(t), M_1) = \int_0^T \phi(t)N(t)dt \to inf, \quad \phi(t) \in C, \quad M_1 \in R. \tag{3}$$

At the last moment of observation - T number of adepts should be no more than one-twentieth of the total number of the community:

$$A(T) \le 0,05M. \tag{4}$$

And the dynamic system is given in the form (1), (2) [5].

Thus, the model of an effective fight against the spread of false information **(MEFASFI)** is an optimal control task: (3), (4), (1), (2). Our goal is a dynamical system represented by (1) a system of differential equations, Being in state (2) for the 0-moment of time, By selecting the control parameters $\phi(t), M_1$, for the last T moment of the observation time, move to state (4), So that the price of this "transfer" $\int_0^T \phi(t)N(t)dt$ is minimal (3).

Conclusion. Thus, it is determined that the proposed mathematical and computer models of spreading and combating false information adequately describe the process under consideration, which is manageable. Control parameters were identified and a model of effective fight against the spread of false information was built, which actually represents an optimal control task and requires further research.

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