

# Methodology of monitoring negative psychological influences in online media

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**Abstract.** The experience of the military aggression of the Russian Federation against Ukraine has shown the relevance and necessity of understanding the problems of moral and psychological support in the Armed Forces of Ukraine in modern conditions. The problem of constant misinformation of the population, the spread of propaganda and the implementation of destructive psychological influence in the interests of the enemy is very sensitive. The simplest tool for distribution misinformation is the Internet (its easy access and wide popularity). The goal of the article is to develop a methodology for monitoring negative psychological influences in online media. The basis of develop methodology is the build a mathematical model using a 4th order polynomial trendline. To determine the number of text messages that were simultaneously processed in statistical analysis, the Hurst exponent was applied. Indicators of negative psychological influences in text messages are selected. Statistical observation is carried out at the expense of a database with text messages from online media. The coefficients of the polynomial regression model are calculated using the least squares method for using a spreadsheet processor Microsoft Excel, or by solving a system of linear algebraic equations using Cramer's method. It has been proved that the developed mathematical model for monitoring negative psychological influences is adequate over the time interval under study. Due to the developed methodology for monitoring negative psychological influences in online media, it is possible to mathematically describe the process of the influence of text messages on a person. The mathematical model underlying the methodology can be used not only at the monitoring stage, but also at the stage of counteracting destructive psychological effects, as well as for the implementation of preventive measures to prevent the spread of such effects by taking into account the frequency and common ways of spreading negative psychological effects in text messages online media. It should be noted that the developed methodology can be used to automate online media monitoring in order to timely identify information threats to military command and control bodies and the personnel of the Armed Forces of Ukraine in the context of ensuring the information security of the state.

**Keywords:** online media, negative psychological influence, regression model, methodology of monitoring

## 1. Introduction

The experience of the military aggression of the Russian Federation against Ukraine and the analysis of the events that preceded the annexation of Crimea and the beginning of hostilities in eastern Ukraine proves the problem of information and psychological support in the Armed Forces of Ukraine in modern conditions. Ukraine's world and own experience shows that the Internet media is an effective tool for waging a hybrid war, namely the implementation of psychological influence on the personnel of the Armed Forces of Ukraine and the population as a whole.

The modern possibilities of online media, combined with scientific and journalistic literature, periodicals, can effectively influence on the mind, consciousness and psyche of millions of people. Information and propaganda have become so powerful today that they can cause the appearance, course and end result of political events, even global problems of peace and war [3].

Online media monitoring in order to early recognition of information threats for the military command, authorities and the personnel of the Armed Forces of Ukraine is one of the main components of ensuring the information security of the state.

For high-quality monitoring activities, it is necessary to develop a methodology for monitoring negative psychological influences based on a mathematical model of their distribution.

*The object of study* is the process of monitoring negative psychological influences.

*The subject of study* is the methodology of monitoring negative psychological influences in online-media.

*The purpose of the article* is to develop a methodology for monitoring negative psychological influences in online media.

### 1.1. Problem statement

With the emergence of new spheres of confrontation in modern conflicts, the methods of struggle have shifted towards the integrated use of non-military measures, including information, that achieve their goal through the use of military force. In modern wars and armed conflicts, special attention is paid to the conduct of information warfare. The parties to the conflict make full use of the Internet to achieve their goals. One of the areas of using the Internet is the distribution of special materials of negative psychological influence through text messages aimed at a specific target audience. The use of methods and methods of waging hybrid wars has turned the information space into a key arena of confrontation between states to achieve national, economic, political, and military goals. The primary purpose of negative psychological

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influence is to change the emotions, motives, objective reasoning, or behavior of the targeted audience.

The phases of a hybrid war are described as follows (figure 1).



**Figure 1:** The phases of a hybrid war.

As can be seen from figure 1, the role and place of the information component at each phase. Mass media such as electronic media, the blogosphere, social networks and other social Internet services (online media) are actively and widely used today as a tool of information warfare to carry out negative influences. The effectiveness of their use, first of all, is due to the massive availability of all segments of the population to them, significantly simplifies the achievement of political, economic, financial and other goals by the subjects of the information war in Russia. Therefore, issues related to monitoring the spread of negative influences are very relevant. Also as is known [1], to conduct quality monitoring, it is necessary to have an appropriate mathematical model. Therefore, when analyzing literary sources, it is necessary to pay attention to the existing mathematical models of negative psychological impact in online media.

## 1.2. Theoretical background

As noted by Ulichev [11], informational influences are an effective tool for manipulating people; therefore, the fact of using Internet services for the implementation of destructive informational influences determines the development of methods and means of resisting these influences. For effective counteraction, it is necessary to study the nature of such influences and the necessary tools for their analysis.

One of the effective means of studying informational influences is mathematical modeling, especially for predicting the further spread of negative influences. The model can make it possible to predict the consequences of a negative psychological influence with the aim of developing preventive measures to prevent them even before they would be implemented.

Online media have become one of the most effective means of spreading psychological influence to change the behavior of the target audience to one that is beneficial to the aggressor.

Ulichev [11] considers a mathematical model of the dissemination of information and psychological influences in a segment of a social network. The network structure is presented as a graph, and the information dissemination is presented as an iterative process. Their formal presentation is also described. However, there is no mathematical apparatus for assessing the level of negative psychological influence in online media.

Savchuk [10] proposes an approach to the construction of a simulation model of the distribution of products of psychological influence in social networks. In this work, the existing approaches, their shortcomings are analyzed and a simulation model based on the logical-analytical one is developed. However, the mathematical apparatus for assessing the level of negative influence spreading in e-media is also not provided.

Mazurenko and Shtovba [6] provides an overview of models for analyzing social networks, but the presented mathematical models are only for analyzing actors of social networks, and not for assessing the level of negative influence.

In [7], a model of a decision-making system is considered for identifying signs of threats to information security in Internet services and assessing their level.

The considered approach is the most relevant for solving the problem posed in this article, since it considers predicting the distribution of text content in online media based on the Hurst exponent.

Qin, Li and Yang [9] present a model and a method developed for commercial use, despite the similarity of the analytical task, the difference is that the authors proposed an approach to analyzing the imp influence act of big data from online media on the short-term and long-term performance of large companies.

The analysis of literary sources showed that currently there is no mathematical model that would allow monitoring negative psychological influences in the online media.

## 2. Results

To develop a methodology for monitoring negative psychological influences in online media, it is proposed to apply the basics of regression analysis. This is because the independent variable (the number of text messages) and the dependent variable (the number of negative psychological influences) can only be related using the regression function.

Text messages from online media refer to time series. The number of text messages that need to be processed simultaneously can be determined using the Hurst exponent [2]:

$$H = \frac{\log(R/s)}{\log(\alpha N)} \quad (1)$$

Hurst empirically calculated constant  $\alpha$  for relatively short-term time series as 0.5, and for information series it is  $\pi/2$  [4].

In the monograph [4] it is shown that for information series for  $N = 20...30$  Hurst exponent  $H = 0.7...0.9$  (this indicates that there is a trend in the time series).

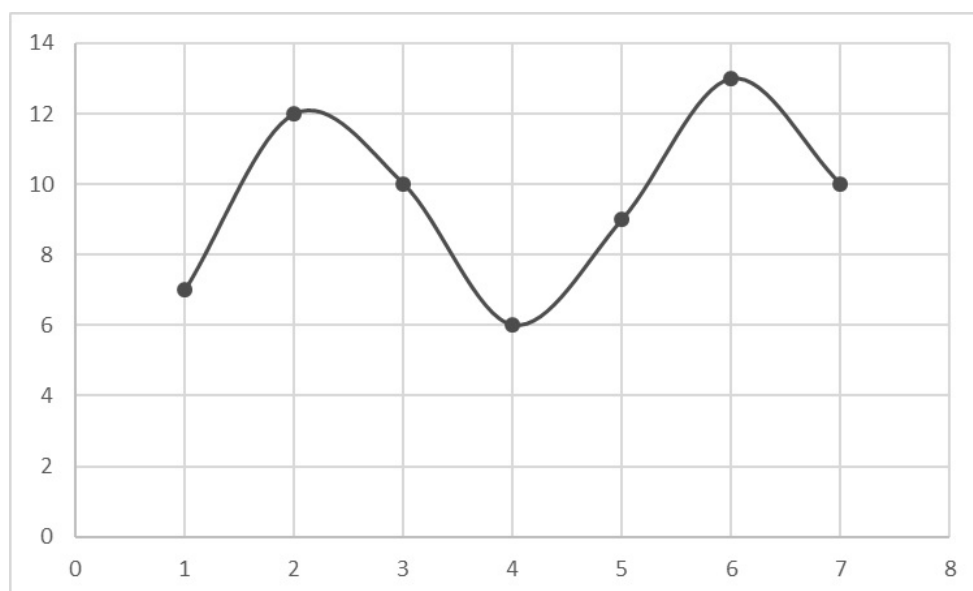
We will assume that as a result of statistical observation of information in online media, the data presented in table 1.

**Table 1**

Number of negative psychological influences.

No.	1	2	3	4	5	6	7
Number of $x_i$	7	12	10	6	9	13	10

In this case, the graph of the function that describing the negative influence in online media has the form shown in figure 2.



**Figure 2:** Graph of negative psychological influences in online media.

Analysis of figure 2 shows that the number of negative psychological influences is described by a graph that has 3 extremums. This indicates that it is advisable to apply a 4th order polynomial trend to describe the obtained time series:

$$f(x) = a_0x^4 + a_1x^3 + a_2x^2 + a_3x + a_4 \tag{2}$$

The coefficients of the polynomial can be calculated using the least squares method. The essence of the method is that the sum of the squares of deviations of statistical values  $y_i$  from the calculated ones  $Y_i = f(x_i, a_1, a_2, a_3, a_4)$  would be the least

$$S(a_1, a_2, a_3, a_4) = \sum_{i=1}^n [y_i - Y_i]^2 = \sum_{i=1}^n [y_i - f(x_i, a_1, a_2, a_3, a_4)]^2 \rightarrow \min \quad (3)$$

Mathematically, the problem of selecting the coefficients of the polynomial is reduced to determining the coefficients of condition (3). We obtain a mathematical model of negative psychological influences in online media:

$$f(x) = -0.2386x^4 + 3.9571x^3 - 22.125x^2 + 47.751x - 22.429 \quad (4)$$

As is known [5], one of the important properties of mathematical models is its adequacy. Adequacy is understood as the correspondence of the parameters (properties) of the model and the modeled object (that is, the parameters obtained as a result of the experiment).

The most common way to test a model for adequacy is to use the methods of mathematical statistics [8]. According to the statistical approach, the actual value of the studied object can be represented as a component:

$$y_i = \hat{y}_i + e_i \quad (5)$$

The adequacy of the constructed model can be evaluated by applying the formulas for evaluating the random values of the residual series:

$$\Delta = \sum_{i=1}^n |x_{mi} - x_{\delta i}| \quad (6)$$

$$\delta = \frac{\Delta}{x_{\delta}} \cdot 100\%$$

We get the results:

$$R^2 = 0.9664; \quad (7)$$

$$\delta = 0.46\%$$

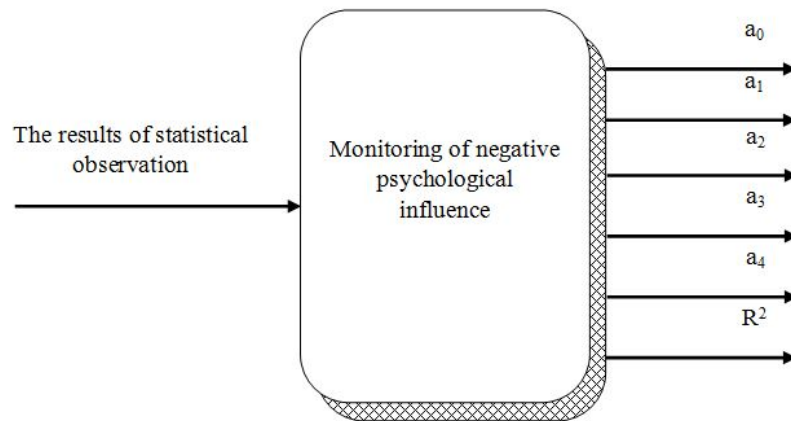
This indicates that the constructed mathematical model adequately describes the negative psychological influences in online media over the time interval that was studied.

To automate the monitoring of negative psychological influences in online media, it is proposed to use the information system as it is a kind of automated system. The main purpose of creating such systems is to provide end users with access to data that is necessary for their practical activities.

DFD diagram (IDEF0) of the information system for monitoring negative psychological influences is shown in figure 3.

This DFD diagram of the information system contains input and output data flow. The information coming to the system is received by means of a neural network as a result of statistical supervision over the information in online media.

At the output of the information system are the parameters of a mathematical model that describes the process of psychological impact on a person, as well as the coefficient of determination, which assesses the adequacy of the constructed model. The analysis of parameters of



**Figure 3:** Monitoring of negative psychological influences.

the received mathematical model will give the opportunity to reveal in due time the information threat which is contained in the information from online media. For example, a change in the parameter  $a_3$  of the constructed model indicates an increase or decrease in the information influence, and a change in the parameters  $a_0, a_1, a_2$  – speed of influence over the simulation time.

Due to the fact that the constructed mathematical model belongs to the time series, to predict the negative psychological influence, it is advisable to use known methods for predicting time series  $\{f(t), t \in T\}$ , given their data for a certain period of time  $T = \{1, \dots, N\}$ .

For the correct choice of the model in the information system the step-by-step algorithm of a choice of an optimum set of working parameters at which specificity of the investigated time series is considered is offered. Thus at each step of monitoring (mathematical modeling) not all class of parameters, and its subset is used.

Decomposition of the context DFD diagram is presented in figure 4. Its structure corresponds to the proposed method.

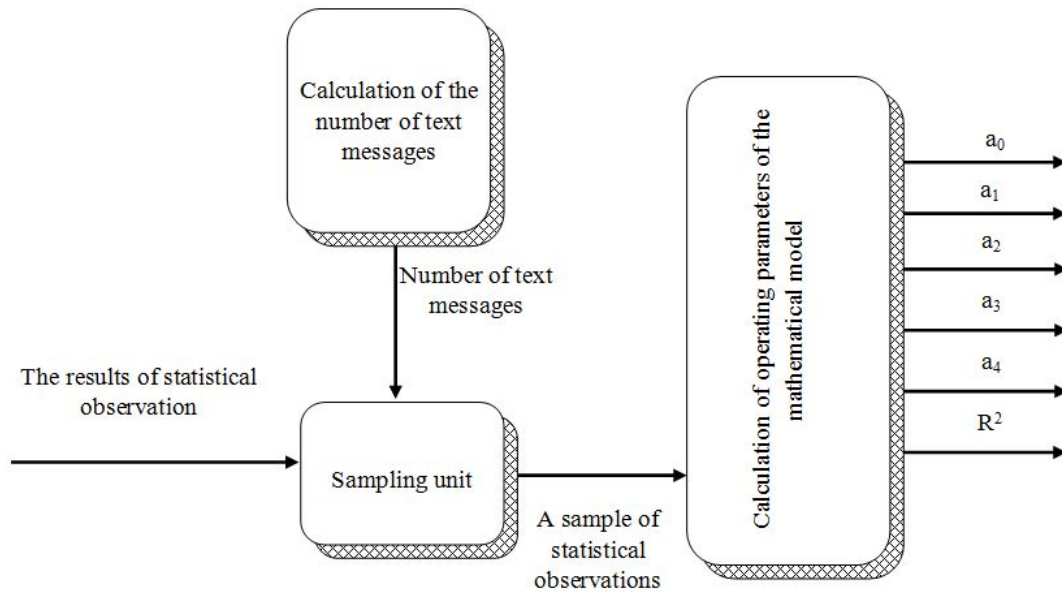
The calculation of text messages that need to be processed simultaneously is performed using the Hearst index (1). In the sampling unit, a sample is formed from the input data flow, which contains the number of text messages corresponding to (1). The calculation of the operating parameters of the mathematical model (regression polynomial coefficients) is performed using the least squares method. Checking the adequacy of the constructed model is carried out simultaneously with the calculation of the operating parameters of the model.

The analysis of the calculated coefficients of the polynomial will allow to estimate changes of negative influence in online media.

### 3. Discussion

Thus, the methodology of monitoring negative psychological influences in online media consists of a sequence of stages.





**Figure 4:** Decomposition of the context DFD diagram.

1. Calculate the number of text messages that must be processed simultaneously using the Hurst exponent (1).
2. Indicators (indicators) of negative psychological influences are set [12].
3. Statistical observation is carried out (counting the number of negative psychological influences that must be processed simultaneously) using information from online media.
4. In accordance with the least squares method, the coefficients of the regression polynomial (operating parameters of the mathematical model) are calculated.
5. The adequacy of the obtained mathematical model is checked by evaluating the absolute and relative errors of the model (7).

## 4. Conclusions

The developed methodology of monitoring negative psychological influences in online media makes it possible to mathematically describe the process of information influence on a person. It should be noted that the developed methodology can be used to automate online media monitoring in order to timely identify information threats to military command, authorities and the personnel of the Armed Forces of Ukraine. Due to the fact that the development of the methodology did not take into account the physical properties of the research object, it can be used to monitor the effects of any nature, and origin during the studying the practices of hybrid wars and disinformation.



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