Automated network and its destructive filler: “re-uploads problem”

To cite this article: E Chapurin et al 2019 IOP Conf. Ser.: Mater. Sci. Eng. 537 052019
Automated network and its destructive filler: “re-uploads problem”

E Chapurin, A Zaryaev, L Parinova and L Popova
Voronezh State Technical University, Moscow ave., 14, Voronezh, 394026, Russia

E-mail: mnac@comch.ru

Abstract. A new mathematical model of filler distribution in an automated network with the active mode of network processes’ moderation along with the „re-uploads problem” taken into consideration is proposed in this work. An active and passive mode of moderation are being compared. SEIR (Susceptible - Exposed - Infectious - Recovered - Susceptible) model was improved taking into consideration filler diffusions and „re-uploads problem”. Also the flow chart showing the multiplicities’ passes states of the embedded modified SEIR model of the N - order was build. For the proposed model a mathematical tool based on Maison’s formula is presented, allowing to calculate the probability of user attacks with the content on segment of the automated network. The findings of this research can be used to automate the modelling of user attacks with the destructive content.

1. Introduction
At present the automated networks and systems can be found everywhere: a huge number of different computer-aided design systems (CAD), computer-aided manufacturing preparation systems (CAM), Industrial automated control systems (ICS) etc. And even the modern social networks are multifunctional systems, which give their users much more functions beside the communication, e.g., trading, advertising, news etc. [1, 2].

Nowadays social networks are multifunctional systems, which give their users much more functions beside the communication, e.g., trading, advertising, news etc.

Social network has a discrete structure: multiple main personal and impersonal sites (societies). Additional pages, such as audio or video lists, photo albums etc. are bounded around them.

Separate pages and messages in societies are hyperlinked, allowing navigation from page to page, from society to society. In general, the hypertext element joins the separate elements into a single communicational space of a social network [3, 4].

From a technical point of view social network «VKontakte» is a three-tier structure. At the top-level of it (the first level) - the hyperformat of a social network, which is a creolized hypertext interactional-communicative space. It bands together the hyperformats of the middle (second) level – personal and impersonal pages. The data, in text form, is at the bottom (third) level. Considering all features of structure and functioning of the social network «VKontakte», we need to analyze the processes of spreading the destructive content with the active moderation, taking into account the „re-uploads problem”.

2. The processes of propagation of the filler of the automated network with an active approach
to moderating processes, taking into account the „re-uploads problem”

To solve the problem of spreading the destructive content in case of small amount of moderators an active moderation is proposed. As the pre-moderation, where the content is added only after the approve of the societies’ admins, may lead to delay in posting even the useful content. Moderators work may be blocked by a huge amount of requests, both complains and new postings. Therefore, the moderators have to look for a destructive content preventive and targeted.

Such an approach has its special features. At the active moderation mode, in distinction from the passive one, if the content is deleted, all the reposts are also removed. Thus, the original content is concerned deleted. The distributors however have the information regarding the existence of this thematic irrespective of the content and also have the copies. Further spreading of this content is being done by those, who have already viewed original postings. Despite, the deleted content will be spread in other forms. This problem has a conventional name „re-uploads problem”.

As an example, a video, containing a destructive content, was blocked in social networks by the court decision, however it is being spread further by the social networks users using other resources.

An existing model of spreading the destructive content SEIR [5-8] does not consider such a problem, therefore the base model gets a modification: after reaching the state, where the destructive content is being spread in the network – \( I_1(t) \). Herewith after detecting of a destructive content the original is being deleted. Based on the information about the deleted destructive content, a new content of the next level is being generated. From the state of spreading the destructive content passes into the state of removal (blocking) the destructive content \( R(t) \), or into the new latent state \( E_2(t) \), where it can be viewed.

This state is called the latent second-order state of content. Its difference from the first-order content is in the another amount of multiplicity of elements. Herewith the content itself stays within the given system of contents. This don’t allow to bring out the second-order states into another system or to make passes looping of multiplicity in the model. The same concerns also the next state \( I_2(t) \), where the second-order content is being spread in the network.

After the active detection the second-order content it is also deleted. Accordingly, the third- and further–orders content is being generated. These orders have states \( E_i(t) \) and \( I_i(t) \), where \( i \) – order of content distribution (spreading), \( i \in \mathbb{N} \). Multiplicity of states \( R \) herewith appears to the general for all the orders within one system.

Concerning the content diffusion the system states are accordingly \( E_i(t) \) and \( I_i(t) \), where \( i \) – order of content distribution (spreading), \( j \) – content order number; \( i \in \mathbb{N}, j \in \mathbb{M} \).

3. Mathematical description of the nested SEIR N-order model, taking into account the diffusion of contents and the „re-uploads problem”

Flow chart showing the multiplicities’ passes states of the embedded modified SEIR model of the \( N \) -order, where content diffusion and „re-uploads problem” are taken into the account, is as follows on the figure 1.

Below is the mathematical representation of the model. Let’s split the total amount of the removed element \( R \), into the elements \( R_i \) of each order:

\[
R = \sum_{i=1}^{n} R_i. \tag{1}
\]

As far as the total amount of the elements inside the system stays unchanged, the overall state is shown using the formula below:

\[
S + \sum_{i=1}^{n} E_i + \sum_{i=1}^{n} I_i + \sum_{i=1}^{n} R_i = N, \tag{2}
\]

differential equation for the system is as follows:
\[
\frac{dS}{dt} + \sum_{i=1}^{n} \frac{dE_i}{dt} + \sum_{i=1}^{n} \frac{dI_i}{dt} + \sum_{i=1}^{n} \frac{dR_i}{dt} = 0. \tag{3}
\]

Figure 1. Flow chart showing the multiplicities’ passes states of the embedded modified SEIR model of the \( N \) - order, where content diffusion and „re-uploads problem” are taken into the account.

Let’s review the elements of multiplicities in details. For this the following indexed are applied:
- \( \beta \) – infection index,
- \( \alpha \) – index of changing the latent state,
- \( k, \gamma \) – index of curing.

For the multiplicity of violable elements differential equation is in following form:

\[
\frac{dS}{dt} = -\sum_{i=1}^{n} S(t) \frac{\beta I_i}{N}, \tag{4}
\]

for the infected distributors:

\[
\frac{dI_i}{dt} = \alpha E_i(t) - \gamma I_i(t), \tag{5}
\]

\[
\frac{dI_i}{dt} = (I_{i-1}(t) - R_{i-1}(t)) \frac{\beta I_i}{N} - (\alpha + k)E_i(t), \tag{6}
\]

for the removed elements:

\[
\frac{dR_i}{dt} = kI_{i-1}(t) - kR_{i-1}(t)) + \gamma I(t). \tag{7}
\]

4. Probabilistic parameters of an automated network filler transition from one state to another

Accordingly, in the model with the active moderation let’s input the probability parameters [9-11] of changing the states of a destructive content. While using the flow chart and equations above along with the Maison’s formula, the probability of infection is:
\[ P_S = \sum_{i=1}^{n} P_{ES} \sum_{k=1}^{n} P_{IS} \sum_{k=1}^{n} P_{RS} \frac{1}{\Delta} , \]  
(8)

\[ P_E = \sum_{k=1}^{n} P_{SE} \frac{1}{\Delta} , \]  
(9)

\[ P_R = \sum_{k=1}^{n} P_{SR} \sum_{k=1}^{n} P_{ER} \sum_{k=1}^{n} P_{RS} \frac{1}{\Delta} , \]  
(10)

where \( \Delta \) is the difference \( 1 - \sum_{i=1}^{4} L_i \). Herewith \( L_i \) makes up an edge of changing the states.

\[ L_1 = \sum_{k=1}^{n} P_{SE} \sum_{k=1}^{n} P_{EI} \sum_{k=1}^{n} P_{IS} , \]  
(11)

\[ L_2 = \sum_{k=1}^{n} P_{SE} \sum_{k=1}^{n} P_{IR} \sum_{k=1}^{n} P_{RS} , \]  
(12)

\[ L_3 = \sum_{k=1}^{n} P_{SE} \sum_{k=1}^{n} P_{IR} \sum_{k=1}^{n} P_{RS} , \]  
(13)

\[ L_4 = \sum_{k=1}^{n} P_{SE} \sum_{k=1}^{n} P_{ES} , \]  
(14)

5. Conclusion
A new mathematical model of filler distribution in an automated network with the active mode of network processes’ moderation along with the „re-uploads problem” taken into consideration is proposed in this work. An active and passive mode of moderation are being compared. Improved SEIR model with the consideration of filler diffusions and „re-uploads problem” is presented on a flow chart, which allows to render the model of distribution the destructive content. For the proposed model a mathematical tool based on Maison’s formula is presented, allowing to calculate the probability of user attacks with destructive content on a regional segment of the social network. The findings of this research can be used to automate the modelling of user attacks with destructive content in societies of the regional segment of social network “VKontakte”.

References
[1] Koçi A and Çiço B 2018 ADLMCC – Asymmetric Distributed Lock Management in Cloud Computing International Journal on Information Technologies and Security \textbf{10} 37–52

[2] Gholami A and Mohammadi M 2018 A Framework for Designing Pharmaceutical Management Information System International Journal on Information Technologies and Security \textbf{10} 33–46

[3] Plotnikov D G, Guzev Yu N, Yázov Yu K, Ponomarenko E N and Kostrova V N 2016 Extended formalization of the description of networks and network conflicts International Journal of Control Theory and Applications \textbf{9} 321–35

[4] Romansky R 2019 A Survey of Informatization and Privacy in the Digital Age and Basic Principles of the New Regulation International Journal on Information Technologies and Security \textbf{1 (11)} 95–106

[5] Ponomarenko E N, Kostrova V N, Babadzhanov R K, Guzev Yu N and Zarubin V S 2016 Discrete risk models of the process of viral epidemics development in homogenous
information and telecommunication networks Journal of Theoretical and Applied Information Technology 92 235–52

[6] Kravets O Ja and Choporov O N 2018 The Problems and Peculiarities of Modelling Integrated Systems of Heterogeneous Traffic Services Journal of Siberian Federal University - Mathematics and Physics 11 581–7

[7] Kravets O Ja, Preobrazhenskiy A P, Kochegarov A V, Choporov O N and Bolnokin V E 2018 Development of algorithms for complex numerical optimization of objects with modular structure International Journal on Information Technologies and Security 10 45–56

[8] Shvartskopf E A, Zaryaev A V, Parinova L V and Popova L G 2016 Modeling of layering growth virus epidemic and spread of harmful content on Poisson networks Research Journal of Pharmaceutical, Biological and Chemical Sciences 7 2321–31

[9] Ivanova Y A 2018 Assessment of the Probability of Cyberattacks on Transport Management Systems International Journal on Information Technologies and Security 10 99–106

[10] Singh K, Singh Dhindsa K and Bhushan B 2017 Deployment of Agent-Based Distributed Defense Mechanism Against DDOS Attacks in Multiple IPS Networks International Journal on Information Technologies and Security 9 123–34

[11] Barabanov V F, Kravets O Ja, Kryuchkova I N, Makarov O Y, Pogodayev A K and Choporov O N 2013 Discrete processes dynamics neural network simulation based on multivariate time series analysis with significant factors delayed influence consideration World Applied Sciences Journal 9 1239–44