Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 119 (2017) 376–385

Procedia Computer Science

www.elsevier.com/locate/procedia

6th International Young Scientists Conference in HPC and Simulation, YSC 2017, 1-3 November 2017, Kotka, Finland

Modelling multistage information spreading in dynamic complex networks

Bakhruz Dzhafarov[a], Daniil Voloshin[a], Max Petrov[a], Nikolay Butakov[a]*

[a]*ITMO University, Saint Petersburg, Russia*

Abstract

In the past few decades of the development of models of information spread through complex networks it became evident that robust assessment and simulation of such processes seems to be feasible when reorganization of the network is neglected. Social networking sites are a particular case of such complication. Moreover, there are few distinctive features of such platforms as environments for multimodal social networks. For instance, the process of issuing informational messages in such networks unfolds though multiple stages. Since some networks incorporate networking and media features, actors issuing and spreading messages can be represented by individual users and aggregate entities (communities and interest groups). In this paper, we assume that information spread and reorganization of network interact: each new wave of reposts of the original post can extend the network, which influences the probability of information bits to be seen by unaffected vertices of the network.

Peer-review under responsibility of the scientific committee of the 6th International Young Scientist conference in HPC and Simulation

Keywords: online social networks; complex networks; SI; epidemiological models; edge rewiring

1. Introduction

The goal of this research is to assess the effectiveness of information dissemination in dynamically reorganizing social networks by creating new edges between central group and users, previously not subscribed to it, but which became exposed to the reposted content from the core group as a result of exploring the information shared by their

* Corresponding author. Tel.: +7967-537-36-99.
E-mail address: alipoov.nb@gmail.com

1877-0509
Peer-review under responsibility of the scientific committee of the 6th International Young Scientist conference in HPC and Simulation
10.1016/j.procs.2017.11.197

neighbors.

This study is motivated by the need to understand the mechanism and properties of information dissemination in dynamic networks in order to reason about these more adequately and come up with better solutions for effective information spreading in cases where it can be crucial. To do so, it is necessary to assess these properties (if they really are manifested). We propose here to develop such a model that can reproduce a step-by-step process of information dissemination (i.e. unfolding in multiple waves), on a specific network topology and observe potential micro effects that it can create.

There are two primary goals set for the research: (a) to construct a model for estimating information propagation characteristics, both for static and dynamically rewiring network; (b) to carry out a parametric study of information propagation characteristics. For the latter one we propose to use two types of parameters: transmission parameters – probability of information to be transferred from user (or a collective entity – group or community) to user; and parameters for edge formation. The extent to which the effectiveness of the distribution changes information in terms of the number of vertices of the social network that had.

Setting of this study builds upon the following logic. At the microscale (covering small time intervals, e.g. hours and days), the effects of heterogeneity of network structure and individual events seem to have more influence on propagation characteristics than at the macroscale (large time intervals, e.g. weeks and months). This means that on the macroscale one can use coarser models in anticipation that the statistical properties would level out the heterogeneity of the network and events.

Some events can produce huge impact on the activities of a whole community. For instance, Saint Petersburg metro explosion that happened at 3 Apr 2017 dramatically increased the number of followers in the “ДТП и ЧП” (Road Accidents and Emergencies) vk.com community [1]. It had 576 072 followers before the explosion and 702 450 after [2], and the repost counts increased from 439 to 798. At the plot below (Fig.1), the density of reposts is presented - it can be concluded that the rates for daily reposting activity has boosted as well. In the process of model development, we used empirical data describing the structure and activity metrics of the said community as a reference.

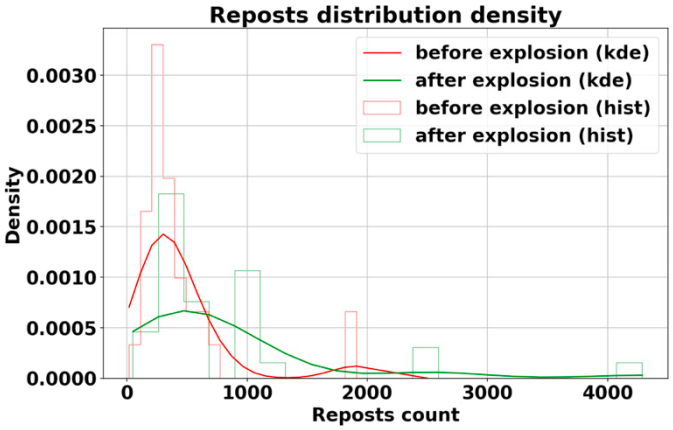

Fig. 1. Distribution for no. of reposts per post in the “ДТП и ЧП” community

We built our model from the intuition informed by the empirical observations. It stands, that rewiring, triggered by multi-wave information dissemination may increase the density of the network over time, which results in conditions where the delivery of the new message to distant, uninformed users is becoming more probable. It is assumed here that such dramatic growth is caused by the perceived usefulness, attractiveness or uniqueness of new content offered to users. It can be as well enforced by users' affective response to certain topics (distress, injustice, common problems etc.). We suppose that users who are exposed to such content first time may subscribe to its source driven by the anticipation of being informed of similar topics in the future.

The most widely used type of models in information spread simulations were originally developed to reproduce the transmission of infectious diseases. There are multiple modifications for these nowadays which emerge under different names, though the most common title is compartmental models. Such models are considered to be applicable