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Social media, diffusion under influence of parameters : survey and perspectives

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Abstract

Social networks are used on a daily basis by millions of individuals who post millions of messages on several topics. The data recorded by these networks provide useful information in order to predict or detect events in the real world. Some diffused messages are misinformation or false rumours, and so, can be the cause of panic or stress situations. In order to avoid and anticipate these critical situations and understand the diffusion phenomenon in general, it is necessary to study and model the propagation of the information. In this sense, several varieties of models have been proposed and some researchers have attempted to identify parameters involved in the information diffusion. In this paper, we introduce well-known diffusion models that generally simplify drastically the process and we present also a survey of more advanced works whether recent or not studying factors that influence the information diffusion. Finally, we give essential perspectives of research toward a more realistic coverage of information diffusion phenomena.

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Keywords: social network ; information diffusion ; diffusion influence factors

1. Introduction

Today, social networks are used on a daily basis by millions of individuals (celebrities, organisations, individuals, trade unions, etc.) which post millions of messages on several topics (politics, sports, health, news, technologies, etc.). These networks are the subject of numerous studies. For example, in the literature, we observe that researchers use diffused messages in social networks to predict or detect events in the real world. In their article, Asur et al.[1] propose a model to predict the revenues generated by the films beyond the fourth week following the film release. Their model uses the messages rate per week, the message rate per hour, the polarity and the subjectivity of the messages. Thanks to these parameters, the model is able to predict the income of films per week quickly with a high probability. In the same way, Bollen et al.[2] use the messages to predict the evolution of stock markets. By extracting the subjectivity of

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messages, they notice that changes in the mood of users are correlated with changes in financial markets. In addition, Tumasjan et al.[3] analyze the messages submitted on Twitter to predict the outcome of a political election by looking at the number of messages posted on a candidate. Other studies are investigating the detection of real-world events. For instance, Sakaki et al.[4] exhibit a model using the messages and their position as sensors in order to inform the population when there is an earthquake. Similarly, Gomide et al.[5] use the messages to detect and locate dengue cases in Brazil. Moreover, social networks are also widely used during emergency situations such as floods[6,7], wildfires[8] and hurricanes[9]. Thus, diffused messages on social networks may provide useful information in order to predict or detect events and save lives.

However, some diffused messages on social networks may have a dramatic impact in the real life. These messages called misinformation or rumours can be the cause of panic situations. For instance, in November 2010 a hacker used the Twitter account of the presidential adviser for disaster management of Indonesia to post a false tsunami warning. Similarly, some messages can accentuate the fear and the anxiety of people, for example, in January 2011 there were rumours of a shooting in the Oxford Circus in London. Mendoza et al.[10] also note same effects provoked by rumours posted on Twitter after the earthquake in Chile in 2010. In an economic context, rumours can bring down the stock market, as for Apple in September 2011, with the false rumour about the death of Steve Job spread on Twitter.

To avoid and anticipate these critical situations, follow rumours, prevent bad reputations, and to better understand the diffusion phenomenon in general, it is necessary to study and model the propagation of the information. In addition, online social networks provide a very useful study field for that. In the sense, several researchers[11,12] have proposed different varieties of models taking the social context into account.

Focusing on the network of the individual[13], the nature of the message[14], the spreader characteristics[15], or external sources[16] some researches have tried to identify the factors which influence the diffusion in terms of volume[17] (i.e., how much), speed[18] (i.e., how fast), recurrence[19](i.e., if information reappears and when), and mutations[20] (i.e., how/why information is altered). Despite these works, we remark that we still have a simplified view of the phenomenon of diffusion in real cases.

Now, to the best of our knowledge, not any work in this field has attempted to consider a complete set of such factors. That is why we found interesting and innovative to propose a survey of the field in this paper along with perspectives we are looking to develop towards a rather complete and more realistic coverage of the information diffusion phenomenon.

In this paper, we introduce some well-known formal models of diffusion and we propose a survey of more or less recent works on parameters that influence the diffusion process in social networks.

The rest of the article is organised as follows: Section 2 presents formal models proposed in matter of diffusion. Section 3 introduces works focus on the individual's network as an engine for influence on information diffusion. Section 4 presents articles that show that the nature of a message has an impact on its diffusion. Section 5 is dedicated to our perspectives. Finally, section 6 concludes this paper.

2. Main reference models in matter of diffusion

Numerous models have been proposed in the literature to study the diffusion process in a population. In this section, we introduce the main reference models in matter of diffusion such as the epidemic models, the agent based models and the probabilistic models.

The spread of infectious diseases and the spread of information seem to have common characteristics in their diffusion. Thus, several models for studying the information diffusion are based on epidemic metaphor. Epidemic models have been initially defined by differential equations[21,22,23]. These first models assume that the population can be divided into a set of compartments such as *Susceptible*, *Infected*, *Recovered* (SIR). In this context, over time, some susceptible individuals become infected, then recovered. In the literature, one can find several improvements or derivations of these models to incorporate more realistic factors. Actually, Zhao et al.[24] added a compartment called *Hibernate* in order to include a mechanism of forgetfulness and remembrance. In their approach, Jin et al.[11] added a compartment called *Sceptic* so as to take into account the scepticism of some individuals about information. In a more recent article, Chen et al.[19] propose that the recovered individuals may become susceptible again in order to simulate the information recurrence.