



Breaking news dissemination in the media via propagation behavior based on complex network theory



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HIGHLIGHTS

- Breaking news diffusion is studied through propagation features quantitatively.
- Combining statistical physics and network theory to analyze news spreading process.
- The propagation network is established to realize the in-depth analysis.
- A new indicator based on complex network is built to describe the feature of nodes.
- Analysis of breaking news diffusion improves information propagation control.

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ABSTRACT

The diffusion of breaking news largely relies on propagation behaviors in the media. The tremendous and intricate propagation relationships in the media form a complex network. An improved understanding of breaking news diffusion characteristics can be obtained through the complex network research. Drawing on the news data of Bohai Gulf oil spill event from June 2011 to May 2014, we constructed a weighted and directed complex network in which media are set as nodes, the propagation relationships as edges and the propagation times as the weight of the edges. The primary results show (1) the propagation network presents small world feature, which means relations among media are close and breaking news originating from any node can spread rapidly; (2) traditional media and official websites are the typical sources for news propagation, while business portals are news collectors and spreaders; (3) the propagation network is assortative and the group of core media facilities the spread of breaking news faster; (4) for online media, news originality factor become less important to propagation behaviors. This study offers a new insight to explore information dissemination from the perspective of statistical physics and is beneficial for utilizing the public opinion in a positive way.

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1. Introduction

Internet users always share online news of a breaking event, especially emergency-related news with each other, and thus shape powerful public opinion. The information diffusion of such news usually has a significant effect on the event and even generates new breaking stories in the process. From 1998 to 2011, the Chinese government dealt with nearly 70% of the

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major breaking events positively referring to public opinion [1]. In addition, lots of breaking events are initially reported by a small number of media outlets with a limited scope of dissemination, while are proceeded by the propagation of massive news outlets resulting in well-known public news in a short time. It is thus interesting to investigate the breaking news diffusion via propagation behavior among media outlets, through which we can also learn how to utilize the breaking news and guide public opinion in a positive way.

In recent years, the increasing online news media has facilitated information dissemination in the expanding social networks [2]. With this increasing of online news media and the consequential growth of information links among them [3], the propagation behavior is increasingly complicated and can be treated as a complex news propagation system. Analyses for such system are difficult because of the complexity of system structure [4,5] and the dynamic propagation behavior [6]. However, with the advance of complex network theory and related studies such as data mining [7,8] and time series analysis [9–14], the analyses for such system have made a great progress [15–17]. Complex network theory offers a new perspective to look at the system consisting of nodes and edges linking these nodes quantitatively and physically, which is helpful in attaining more deeper and comprehensive understanding [18–22]. By transforming the information diffusion system into networks, [23–25] have shown sufficiently the validation and robustness of complex network theory application to the information domain.

There are studies applying complex network theory to the breaking-events diffusion, especially in the field of online social networks [26,27]. Researchers found that social media play important role in breaking news diffusion [28–31]. In the news transmission process, spreading on microblogs [32,33], twitter [34,35] and forums [36] have been widely discussed, opinions [37,38] and rumors have emerged [39–41] as well as clustering activities [42,43]. Because of the significant influence of news spreading [44], measures are explored to help control the flow of information [45] such as identification of individual disseminators [46–49]. However, news media outlets have larger influence on the public because of their broader audience. It is therefore innovative and meaningful to study the information diffusion among news media. Furthermore, each type of breaking event has its own diffusion features, which requires more accurate and targeted results for emergency response guidance.

The main contribution of this study to the literature is extending the complex network theory application to the news media research and studying the breaking news diffusion via propagation behavior among media outlets. Drawing on the news data of Bohai Gulf oil spill event from June 2011 to May 2014, we constructed a complex network model in which media are set as nodes, the propagation relationships as edges and the propagation times as the weight of the edges. Through this weighted and directed network, this study examined innovatively the underlying propagation features of news media including online media, print media and their corresponding online portals, which consider the physic features and their practical significance simultaneously. The results offer practical implications for the information transmission monitoring and guidance. The remainder of this paper is organized as follows: data and network model construction is illustrated in Section 2, followed by the propagation features and analyses in Section 3. Section 4 is the concluding remarks of this paper.

2. Data and method

2.1. Data

Microblog users initially disclosed the news that the ConocoPhillips's oil wells spilled in the Bohai Bay in June 2011. This event has been reported for three years in China and is called “the 2011 Bohai Bay oil spill” (https://en.wikipedia.org/wiki/2011_Bohai_Bay_oil_spill). It is an emergent disastrous event with such general features of breaking events as emergency, unpredictability, disaster, social publicity and long-term propagation effects. It attracted a great deal of attention after its first disclosure. In this paper we thus chose the 2011 Bohai Bay oil spill as a representative case of breaking events.

We gathered and pretreated all the Chinese news headlines in the search results on this event from Baidu (<http://www.baidu.com>), the most popular and well-known Chinese search engine. “Bohai Bay oil spill”, “Penglai oil spill” and “ConocoPhillips oil spill” are the keywords used in the search. We acquired 2105 news report pages in total from June 2011 to May 2014 and grouped the structure of information from all pages. We grouped various reporters whose reports originated from the same media portal into one source. For example, “Sohu”, “Sohu Finance” and “Sohu Public” were found collectively under “Sohu”. Finally, 1159 pieces of useful news were used as sample data in this study. Each datum is composed of the news headline, the news website and the propagation source.

The majority of the news are Chinese because the 2011 Bohai Bay oil spill event happened in China, native media had reported more timely and they tracked more closely during the past three years. Hence, we mainly focus on the Chinese media and their reports.

2.2. Network modeling

The propagation network was built based on the relationships between news media outlets. The media outlets reporting the Bohai Bay oil spill news – including pure online media and the online portals of print media – are set as nodes and the propagated relationships between the media are set as edges. The direction of each edge is drawn from the news source to the target media; for example, the direction will run from A to B if A is propagated from B. The propagation times are the

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