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EDITED AND REVIEWED BY
Matjaž Perc,
University of Maribor, Slovenia

*CORRESPONDENCE
Xuzhen Zhu,
zhuxuzhen@bupt.edu.cn

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Editorial: Network mining and propagation dynamics analysis

Xinyi Wang[1], Yuexia Zhang[2], Xuzhen Zhu[3]*, Fei Xiong[4], Wei Wang[5] and Shirui Pan[6]

[1]Key Laboratory of Information and Communication Systems, Ministry of Information Industry, Beijing Information Science and Technology University, Beijing, China, [2]Key Laboratory of Modern Measurement and Control Technology, Ministry of Education Beijing Information Science and Technology University, Beijing, China, [3]State Key Laboratory of Networking and Switching Technology, Beijing University of Posts and Telecommunications, Beijing, China, [4]School of Electronic and Information Engineering, Beijing Jiaotong University, Beijing, China, [5]School of Public Health, Chongqing Medical University, Chongqing, China, [6]School of Information and Communication Technology, Griffith University, Nathan, QLD, Australia

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Editorial on the Research Topic
Network mining and propagation dynamics analysis

1 Introduction

Many phenomena in the fields of computer science, biology, sociology, and economics can be described as transmission dynamics on complex networks. Propagation dynamics on complex networks can be used to describe many propagation phenomena in the real world [1, 2]. The modeling of communication dynamics based on complex networks and its intervention research are of great practical significance. For example, they can provide decision-making bases for the prevention and control of diseases, rumor control, and product marketing. In many real-life propagation phenomena, we often wonder about the mechanisms and laws of their propagation on complex networks and their predictive methods and means of control. We can have a clear and comprehensive understanding of the evolution mechanism, propagation process, and steady state of real phenomena by clarifying the above questions. Furthermore, it also provides some necessary theoretical support for predicting and controlling real systems.

The study of link prediction mainly uses the known information of various network structures to compute the similarity between the nodes in a network without a connection and to obtain the possibility of the lost connection in a network or the connection that will be generated in the future. With the rapid development of network science, the study of link prediction is closely related to the structure and evolution of networks. At the same time, these studies can also help us to theoretically understand the evolution mechanism of complex networks, thus better deriving the propagation dynamics of complex networks.

For this purpose, this Research Topic in Frontiers in Physics intends to clarify the contribution of the rapidly developing research field of complex networks. We encourage articles that use multidisciplinary methods for complex network data mining, such as machine learning, information theory, applied mathematics, and computational statistical physics. We also invite researchers to write original research articles. Potential topics include but are not limited to the following.

- Trend analysis of social network information dissemination
- Analysis of the spread trend of infectious diseases
- Analysis of the computer virus transmission process
- Link prediction on social networks
- Behavior analysis on social networks
- Network state prediction
- Behavior pattern recognition
- Personalized recommendation systems

2 Presentation of the papers

The first paper, titled "*Ambient Air Pollution and Hospitalization for Acute Myocardial Infarction in Chongqing, China: A Time-Stratified Case Crossover Analysis*" [3](Zhao et al.), focuses on short-term exposure to ambient air pollution on acute myocardial infarction (AMI) with limited and inconsistent evidence; investigates the relationship between air pollution and acute myocardial infarction hospitalization in Chongqing, China; and further studies and determines, from the epidemiological and physiological perspective, the causal relationship between air pollution, meteorological factors, and acute myocardial infarction. The experimental results suggest that short-term exposure to PM2.5, PM10, SO2, NO2, and CO helps to increase AMI admissions, which have public health implications for primary prevention and emergency health services. This paper provides clear evidence that AMI hospitalization can be increased by ambient air pollution in Chongqing, China.

The second paper, titled"*Cascade Prediction with Self-Exciting Point Process and Local User Influence Measurement*" [4] (Zhao et al.), proposes a prediction model of information cascades in social networks based on the Hawkes process, which considers post influence, user influence, and user response time to describe the occurrence probability of forwarding events. The authors present a new method of calculating user influence, combined with semi-local centrality and local clustering coefficients. A regression tree algorithm is used to determine time correction coefficients to reveal dynamic post influence, and the popularity prediction of posts on social networks is realized. Comparison experiments of different models are carried out on real-world datasets and the results show that our method outperforms other counterparts.

The third paper, titled "*Analysis of information propagation and control of a layered SITR model in complex networks*" [5] (Pan et al.), proposes a novel L-SITR model that stratifies information propagators based on nodal influences and improves the traditional SIRS model by adding rational propagators. Through the study of the theoretical analysis of dynamics equations, the authors determine the spread of the L-SITR model threshold and, combined with numerical simulation, prove the stability of the equilibrium point. To suppress the large-scale spread of online public opinion information, optimal control is applied to the L-SITR model. The results show that the proposed L-SITR model has higher accuracy than the traditional SIRS model and is more suitable for information propagation prediction in the presence of rational communicators. The optimal control method proposed in this paper can effectively reduce the influence of public opinion propagation.

The fourth paper, titled "Asymmetric evolutionary game analysis of emergency cooperative social networks for magnitude emergencies: Evidence from the Beijing-Tianjin-Hebei region in China" [6] (Nan et al.), uses social network analysis (SNA) and an asymmetric evolutionary game model based on the data set of the cooperative fight against COVID-19 of the Beijing-Tianjin-Hebei region in China. The authors found that the asymmetry between regions is comprehensively determined by resource endowment, administrative level, geographical distance, regional vulnerability, political pressure, and other factors; vertical control is still the main operating mechanism of ECSNs. Network derivation is caused by the superposition of multiple factors, and obstacles may arise from which political factors are very important and asymmetry.

The fifth paper, titled "*Effect of social media rumors on stock market volatility: A case of data mining in China*" [7] (Zhang et al.), identifies patterns from social media rumors from financial forums using machine learning, quantifying social media rumors based on statistics and analyzing the mechanism of propagation and influence of social media rumors on stock market volatility using econometric models. The results show that rumors have an important information transmission effect on stock market volatility and the constructed Internet Financial Forum Rumor Index is helpful in understanding the potential impact of rumors. These research results are of guiding significance for optimizing the information environment and are conducive to promoting the healthy and stable development of the securities market.

The sixth paper, titled "*The study of new energy vehicle choice in China from the perspective of a complex neural network*" [8] (Liu et al.), uses the Bert-wwm-ext model structure, data mining, and deep learning to study the new energy vehicle selection and also analyzes the positioning of domestic and foreign new energy vehicle brands and their brand development from the perspective of complex networks. The results show that: 1) Consumers are paying increasing attention to the quality of new energy vehicles; 2) Consumer satisfaction with the endurance of pure electric vehicles and plug-in hybrid electric vehicles varies significantly; 3) Consumer evaluation is positively correlated with car prices; and 4) The head effect of Chinese brands is significant, and foreign brands have formed strong brands with high brand premium.

The seventh paper, titled "*Role of degree and weighted coreness based on endpoints in link prediction*" [9] (Hao et al.), proposes a weighted hybrid influence model based on the degree and coreness (WDCHI) and compares the prediction results of the WDCHI with those of CN, AA, RA, LP, SRW, CSRW, HSRW, and SHI. The results show that WDCHI exhibits the same computational complexity and performs better than other models on the metric AUC. Moreover, this finding can be used to improve social networks, computer networks, communication networks, and other types of networks.

The eighth paper, titled "*MPDNet: A Transformer-based real-time passenger detection network in metro stations*" [10] (Yang et al.), suggests a subway passenger detection network based on the transformer model (MPDNet), which can detect dense passenger flow in the installation angle of the subway video surveillance system. Moreover, the authors propose a MetroStation dataset based on subway surveillance video to better evaluate the performance of the model in the metro. This dataset reflects multiple scenarios in subway stations compared to other pedestrian detection datasets. The experiments on the MetroStation dataset show that the MPDNet performed better.

The ninth paper, entitled "*City network mining in China's Yangtze river economic belt based on "two-way time distance"modified gravity model and social network analysis*" [11] (Chai et al.), studies the inter-urban connectivity strength, structure, density, and distribution

pattern of urban networks along the Yangtze River Economic Belt in China using the SNA method, "Dual-direction time distance" modified gravity model, and ArcGIS geographic visualization method. The results show that the modified gravitational model can better reveal the interaction differences between cities and reflect the current and potential economic, population, and resource relations between cities, and this finding has a high application value for the mining of regional urban network structures.

The 10th paper, titled "*Social contagion influenced by active-passive psychology of college students*" [12] (Ye et al.), explores the effects of behavioral psychology on social transmission on campus and establishes a threshold model of active and passive student behavior in weighted networks to conceptually study the effects of psychological heterogeneity. The theoretical study and simulation results show that active students encourage the acceptance of new behaviors and the dissemination of information. However, as the proportion of active students declines, the growth pattern shifts to a discontinuous phase transition.

The 11th paper, titled "*Hawkes processes for understanding heterogeneity in information propagation on Twitter*" [13] (Wang et al.), discusses the heterogeneity of study users during information dissemination and, finally, proposes an improved Hawkes model. The theoretical study and simulation results show that the improved Hawkes model has higher prediction accuracy for wave peaks during propagation and is more accurate in the prediction of peak occurrence. The improved Hawkes model is an effective communication model for detecting and quantifying the super-spreaders in the transmission process, which has a certain guiding significance in the control and prediction of information transmission in social media.

The 12th paper, titled "*A spatial network analysis of vegetable prices based on a partial granger causality approach*" [14] (Shen et al.), takes garlic as an example and presents a vector autoregression model, analyzing relations of the price transmission between producing and selling cities. The authors use the partial Granger causality test to determine the direction and path of price transmission between the main producing areas and the main consuming areas. The theoretical study and simulation results reveal the features of agricultural product price transmission in China and provide reasons and evidence for market regulation.

The 13th paper, titled "*Modeling hierarchical attention interaction between contexts and triple-channel encoding networks for document-grounded dialog Generation*" [15] (Cai et al.), proposes a neural network generative model with attention mechanisms for document-based, multi-session conversations. The model encodes the discourse context containing a given document, dialog history, and last speech as a distributed representation through three channels. The authors introduce hierarchical attention interactions between conversation context and previously generated utterances to generate appropriate responses. Comparing the model with the various baselines on the dataset, CMU_DoG shows that the proposed model performs better than the other related models.

The 14th paper, titled "*An opinion dynamics model based on affinity and social noise*" [16] (Liu et al.), introduces affinity and social noise in the Hegselmann–Krause model of opinion dynamics and proposes an affinity and social noise Hegselmann–Krause model (ASNHK) based on the social influence theory and the Hegselmann–Krause model of opinion dynamics. The model incorporates affinity and noise into the HK model and studies the influence of affinity, the affinity threshold, social noise, and human heterogeneity on the evolution of opinions. The results show that, first of all, affinity between people can improve their opinions toward forming a consensus positively, but the affinity threshold has a negative role. The authors state that this study introduces affinity and social noise in the Hegselmann–Krause model of opinion dynamics, provides a new perspective on the social influence theory, and enriches the application of this theory in opinion dynamics.

The 15th paper, entitled "*Combining NSP and NER for public opinion event extraction mode*" [17] (Zhang et al.), proposes an opinion event extraction model combining NSP and NER (NN-EE) to alleviate the deficiency of the combined event parameter extraction performance by introducing NER technology. At the same time, the authors incorporate the event-triggered features into the NSP mechanism of the pre-trained language model, BERT, prompting the model to learn the deep semantic interaction between event-triggered and the original text. Experimental results show that the model achieves the optimal performance on the authors' self-constructed food opinion report dataset FD-OR, which verifies the effectiveness of the model.

The last paper published in this Research Topic, entitled"*MERP: Motif-enhanced network embedding based on edge reweighting preprocessing*" [18] (Lv et al.), proposes a motif-enhancement framework for network embedding based on edge reweighting. Through edge reweighting, the weight of redundant noise edges between motifs is decreased. The authors apply edge reweighting as a preprocessing phase in network embedding and construct the motif-enhanced network by incorporating enhanced motif structures with the original network, allowing the embedding of vectors from the enhanced network for better performance in downstream network analysis tasks. The results show that this framework performs better than state-of-the-art network embedding methods.

We thank all the authors for their contributions and hope that this Research Topic will encourage more scientists to deepen their research on the development of complex network mining and the analysis of propagation dynamics.

Author contributions

XZ, XW, and YZ organized the idea. XZ, XW, and YZ wrote the paper. FX, WW, and SP reviewed the paper and made revisions.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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