復旦大學
FUDAN UNIVERSITY

Frontier Forum of Network Science

Conference Proceeding

Shanghai·China

2016. 06. 16

Frontier Forum of Network Science

Time: 16th June, 2016

Address: Room 52, Henglong Physical Building, Fudan University, Shanghai

Main topics:

Frontier of network science covering both theory and applications

Workshop Sponsor:

Research Center of Smart Networks and Systems, School of Information Science and Engineering, Fudan University

Workshop Time and Address:

✧ Time:

Registration: 2016 June 15th (Wednesday)

Conference: 2016 June 16th (Thursday) 9:00-16:30

✧ Visiting address:

Room 521, Henglong Physics building, Fudan University, 220 Handan road, Yangpu District, Shanghai, China

（复旦大学恒隆物理楼 521 会议室）

WIFI Information：

WIFI：fduwireless

username：ffns2016 password：RCSNS

Contact:

Cong Li: Email: cong_li@fudan.edu.cn Tel: 17702103036

Research Center of Smart Networks and Systems
School of Information Science and Engineering
Fudan University

16th June, 2016

Map of Fudan University

复旦大学地图及相关交通信息：

Address information（地址信息）:

A. 复旦大学:上海市杨浦区邯郸路 220 号，恒隆物理楼
(Henglong Physical building, 220 Handan Road,Yangpu district, Shanghai)
B. 皇冠假日酒店：上海市杨浦区邯郸路 199 号(近复旦大学)
(Crowne Plaza Fudan Shanghai, No. 199 Handan Road, Yangpu district, Shanghai)
C. 复宣酒店：上海市杨浦区国定路 400 号复旦大学新闻学院院区内(近邯郸路)
(Fu Xuan Hotel, No. 400 Guoding Road, Yangpu district, Shanghai)
D. 燕园宾馆：杨浦区政通路 270 号(近国定路)
(Yan Yuan Hotel, No. 270 Zhengtong Road, Yangpu district, Shanghai)

Schedule

16th June, Thursday

Morning

9:00–9:05 **Welcome**
Prof. Xiang Li

Chair: Xiaofan Wang

9:05-9:45 **Time-varying SIS prevalence in networks: theory and a new approximate formula**
Prof. Piet Van Mieghem (Delft University of Technology)

9:45-10:15 **Network control and its application to nervous systems**
Dr. Gang Yan (Northeastern University)

10:15-10:30 Group Photo and Break

Chair: Huijuan Wang

10:30-11:00 **Temporal network modeling of social interactions: from face-to-face contacts to echo chambers**
Dr. Michele Starnini (Universitat de Barcelona)

11:00-11:30 **Game Optimization for the Unreliable Wireless Cooperations with Indirect Reciprocity**
Dr. Changbing Tang (Zhejiang Normal University)

Lunch

16th June, Thursday

Afternoon

Chair: Piet Van Mieghem

14:00-14:40 **Quantization Effect on on Complex Networks**
Prof. Xiaofan Wang (Shanghai Jiao Tong University)

14:40-15:10 **Epidemic Mitigation via Awareness Propagation in Communications Network: the Role of Time Scale**
Dr. Huijuan Wang (Delft University of Technology)

15:10-15:25 Break

Chair: Cong Li

15:25-15:55 **Estimating Epidemic Thresholds in a Temporal-networked Cyber-social Population**
Dr. Yiqing Zhang (Fudan University)

15:55-16:25 **On "Familiar Stranger" Phenomenon in a Large-scale VoD System**
Dr. Yuedong Xu (Fudan University)

16:25-16:45 **Resource allocation for D2D communication in cellular networks: A matching theory framework**
Yiling Yuan (Fudan University)

16:45 **Closing**

Prof. Xiang Li

17:30 Banquet

16th June, Thursday

Morning

Time-varying SIS prevalence in networks: theory and a new approximate formula

Piet Van Mieghem
Delft University of Technology

Abstract:

Currently, epidemic spreading processes on networks are popular to model several diffusion phenomena in real-world networks. After reviewing some basics about the continuous-time SIS Markov process on networks, we will focus on the SIS prevalence, which is defined as the expected fraction of infected nodes in the network. Recently, we have derived an exact differential equation for the SIS prevalence on any fixed network, containing the Laplacian matrix of the underlying graph. Based on that exact differential equation, the time dependence of the SIS prevalence is first studied and then upper and lower bounded by a new, explicit analytic function of time. Our new approximate formula obeys a Riccati differential equation and bears resemblance to the classical expression in epidemiology of Kermack and McKendrick (1927), but enhanced with graph specific properties, such as the algebraic connectivity, the second smallest eigenvalue of the Laplacian of the graph. A comparison with the N-Intertwined Mean-Field Approximation (NIMFA) and simulations of the exact continuous-time Markovian SIS process on a graph exhibit the accuracy and the potential of the new analytic formula.

Network control and its application to nervous systems

Gang Yan
Northeastern University

Abstract:

Recent years have witnessed an explosion of studies pertaining to control issues in complex networks. In this talk we will present two progresses - spectrum of network control, and experimental confirmation of the control principles in C. elegans nervous system.
* For the spectrum of network control we will show that the variability of control energy for different directions of the state space depend strongly on the number of driver nodes. In particular, if all nodes are directly driven, control is energetically feasible, as the maximum energy increases sub-linearly with the system size. If, however, we aim to control a system through a single node, control in some directions is energetically prohibitive, increasing exponentially with the system size. For the cases in between, the maximum energy decays exponentially when the number of driver nodes increases.
* To analyze the C. elegans nervous system we map its responsive behaviors into a network control problem with specific sensory inputs and muscular outputs, predicting the previously unknown role of several neurons in worm locomotion. We validate these novel predictions through cell-specific laser ablation and worm tracking experiments. We also show that our predictions robust to missing and rewired connections in the existing data, indicating the applicability of these techniques to larger and less well-characterized nervous systems. Our results offer the first direct experimental confirmation of the predictive power of network control principles in living systems.

Temporal network modeling of social interactions: from face-to-face contacts to echo chambers

Michele Starnini
Universitat de Barcelona

Abstract:

The temporal network approach has been successfully applied within the framework of human dynamics modeling. Here we present a set of simple models able to reproduce different features of social interactions in the physical space, from empirical data of face-to-face contact networks to metapopulation structures, where individuals segregate into different groups. The models describe agents that perform a random walk in a two dimensional space and are endowed with a continuous variable, representing his status or opinion, that can be static or dynamical. The simplest case in which a quenched variable represents an individual's 'attractiveness', whose effect is to slow down the motion of people around them, is able to account for several structural and temporal properties of human contact networks, measured across a variety of different social venues. Relaxing the assumption of an immutable trait of individuals allows for the introduction of social influence, resulting in a progressive convergence of the status/opinion variable in response to physical proximity. The interplay between social influence and homophily, i.e. the preference of the individuals to be rounded by similar peers, leads to the emergence of a metapopulation scenario. Finally, the further introduction of confirmation bias in social interactions, defined as the tendency of an individual to favor opinions that match his own, leads to the emergence of echo chambers where different opinions can coexist also within the same group.

Game Optimization for the Unreliable Wireless Cooperations with Indirect Reciprocity

Changbing Tang
Zhejiang Normal University

Abstract:

Cooperation in packet forwarding among wireless users and network operators has been widely studied in wireless communication. However, because of the limited computation resources, players in wireless communication will not cooperate with others unless cooperation can improve their own performance. In this talk, we model the unreliable packet forwarding among participants as an indirect reciprocity game. Also, we theoretically analyze the optimal action rule, and derive the approximate threshold of benefit-to-cost ratio to guarantee the achievement of the optimal action rule. Furthermore, we adopt the replicator dynamic equation to evaluate the evolutionarily stability of the optimal action rule against the perturbation effect. Finally, we give numerical illustrations to verify the efficiency and effectiveness of our proposed algorithm.

16th June, Thursday

Afternoon

Quantization Effect on Complex Networks

Xiaofan Wang
Shanghai Jiao Tong University

Abstract:

Weights of edges in many complex networks we constructed are quantized values of the real weights. To what extent does the quantization affect the properties of a network? In this work, quantization effects on network properties are investigated based on the spectrum of the corresponding Laplacian. In contrast to the intuition that larger quantization level always implies a better approximation of the quantized network to the original one, we find a ubiquitous periodic jumping phenomenon with peak-value decreasing in a power-law relationship in all the real-world weighted networks that we investigated. We supply theoretical analysis on the critical quantization level and the power laws.

Epidemic Mitigation via Awareness Propagation in Communications Network: the Role of Time Scale

Huijuan Wang
Delft University of Technology

Abstract:

The pervasiveness of the Internet and smartphones enables individuals to participate in multiple networks such as communications networks and the physical contact network. The feedback between these networks opens new possibilities to mitigate epidemic spreading. For instance, the spread of a disease in a physical contact network may trigger the propagation of the information related to this disease in a communications network e.g. online social network, which in turn may increase the alertness of some individuals resulting in their avoidance of contact with their infected neighbors in the physical contact network, possibly protecting the population from the infection. In this talk, we explore how the time scale of the information propagation (speed at which information is spreaded and forgotten) in the communications network relative to that of the epidemic spread (speed that an epidemic is spreaded and cured) in the physical contract network influences such mitigation using awareness information.

Estimating Epidemic Thresholds in a Temporal-networked Cyber-social Population

Yiqing Zhang
Fudan University

Abstract:

Nowadays, ubiquitous information technologies make us easily to collect human close proximity interactions as large scale and high resolution data, and modern temporal network theory provides a new scheme to represent these data. Therefore, epidemic processes in temporal networks can describe infectious diseases of populations more really and comprehensively. Here, I introduce a stochastic model to capture SIS epidemic processes in three typical kinds of temporal networks, i.e., periodic, Markovian and link activation networks, which represent three methods to deal with real data of human close proximity interactions. We obtain that epidemic thresholds are all in terms of the largest eigenvalue - the spectral radius - of the weighted average adjacency matrix devised from the corresponding temporal networks, which paves a new way to control epidemic outbreaks on temporal networks. Moreover, we demonstrate that the time-reversal characteristics of temporal networks do not change their epidemic thresholds, but their temporal statistics of bursts and heterogeneity perform opposite influences on the epidemic thresholds, which provides a criterion to evaluate the impact of nontrivial temporal characteristics of links on epidemic thresholds.

On "Familiar Stranger" Phenomenon in a Large-scale VoD System

Yuedong Xu
Fudan University

Abstract:

Internet users never stop generating data. Take VoD (Video-on-Demand) systems as example, users leave footprints on the server with every click. The footprints include information such as user ID, timestamp, requested video, etc. These data not only reveal user behavior patterns, but also carry information about the relationship between independent users. In this work, we introspected into the dynamic user graph of VoD systems. We called a pair of users who share multiple videos in their viewing records 'familiar stranger' of each other. Based on our Tencent Video dataset, a dynamic familiar stranger network that evolves within time was constructed using network science concepts and community detection algorithms. Features similar to those of scale-free network are spotted and significant community structures are found in our familiar stranger network. We also showed that a significant amount of long-term evolving dynamic communities existed in the network. Our discoveries is helpful in constructing user communities and generating attractive video content. Our findings also show potential in improving recommendation and content distribution systems.

Resource allocation for D2D communication in cellular networks: A matching theory framework

Yiling Yuan
Fudan University

Abstract:

One big challenge for implementing D2D communication is how to allocate spectrum resource for D2D communications. Recently, it has been proposed that both the D2D users and cellular users share the same licensed spectrum, namely, underlay D2D and overlay D2D. For the former, both user the same spectrum at the same time. For the latter, dedicated resource is allocated for D2D links. However, in both modes, the performance of cellular users will be impaired. We will investage a cooperative spectrum sharing scheme, where D2D user can serve as a relay for the cellular edge user(CEU) to earn opportunity to access the licensed spectrum band. Based on matching theory, stable D2D-CEU pairs will be formed given the preferences of both sides. Thus, both sides have intentions to cooperate mutually and win-win is achieved finally.

Sponsor :

Research Center of Smart Networks and Systems
School of Information Science and Engineering
Fudan University