2013 年"随机图与复杂网络"学术研讨会

由华东师范大学应用数学与交叉学科研究中心与上海交通大学复杂系统研究所举办的"随机图与复杂网络"学术研讨会初步计划将于 2013 年 11 月 16 日至 17 日在华东师范大学举行。

此次研讨会将主要围绕如下若干专题交流、讨论：

- 大规模网络理论及应用

- 大规模网络上 Web 马氏骨架过程的理论及其应用

- 大规模随机网络序列的变点监测和诊断

- 大规模网络中的博弈论与优化设计

- 大型软件可靠性测试的数学理论

- 大规模网络上的随机游动相遇问题、排队问题以及分枝过程与超过程研究

- 现代概率方法在随机图与广义随机图中的应用

- 随机图上的随机游动、异常扩散和相互作用粒子系统

- 复杂网络的构造，特征刻划以及其上的随机过程

- 随机图、小世界网络等网络模型拓扑性质、谱特征等

- 网络的统计特征与 Tutte 多项式

- 与复杂网络相关的理论、模型、方法及算法研究

会议安排如下：

1. 报到时间：2013 年 **11 月 15 日下午 14：00—22：00**。

2. 报到地点：上海金沙江大酒店 上海市普陀区怒江路 257 号（近金沙江路，华东师范大学边）。

3. 会议报告地点：华东师范大学理科大楼 1414 教室。

2013 年"随机图与复杂网络" 学术研讨会日程安排

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<tr><td>9：15－9：50
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<tr><td>9：50-10：25
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18:20 晚宴

		8:30-9:50 （含提问时间）	薛学峰博士： 北京大学 题目：齐次图上的随机感染权重接触过程
11 月 17 日 上 午		8:50-9:10 （含提问时间）	夏敏博士：上海交通大学 题目：An Approach on Network Games
		9：10-9：30 （含提问时间）	李彦博士: 上海电力学院， 上海交通大学 题目：The limit density of connected components in a graph process
		9：30-9:50 （含提问时间）	康慧燕博士： 上海大学 题目：Epidemic spreading and global stability of an SIS model with delay on heterogeneous networks
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		10：20－10:40 （含提问时间）	袁炜罡 博士: 上海交通大学 题目： Spectra of random graphs
		11：40-11：00 （含提问时间）	董燕： 上海交通大学 题目：Bounded synchronization of stochastic multi-agent systems with nonidentical agents and time delays
		11:00-11:20 （含提问时间）	晋亚磊博士：上海交通大学 题目：
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网络优化与网络博弈算法

胡晓东　中科院

在现代大规模网络优化设计和应用中，规划者从整体利益出发，优化设计网络以达到整体最优，但网络应用中的参与者却是从自身利益出发，做出自私的行动选择以达到个体最优；这常常使得网络系统的实际性能低于规划者期望的整体最优。这个矛盾为网络优化设计提出了一个亟待研究解决的新问题：如何设计网络使得其性能在应用中能够真正实现。

近十年来人们提出的一个方法就是，将网络的设计及运作都分别视为一个网络博弈，从博弈的角度研究网络优化设计的算法问题。在本次报告中，我们将概述博弈算法的主要思想，并简单介绍我们最近在环形网络上的自私路由问题的两个研究结果和排序问题的一个博弈模型及结果。

Mixing Time of Random Walk on Poisson Geometry Small World

吴宪远　　首都师范大学

Let's consider the supercritical Poisson continuous percolation on d-dimensional torus T^d_n with volume n^d. By adding ``long edges'' randomly to the largest percolation cluster, we obtain a random graph $\fG_n$. In the present paper, we first prove that the diameter of $\fG_n$ grows at most polynomially fast in $\ln n$ and we call it the {\it Poisson Geometry Small World}. Secondly, we prove that the random walk on $\fG_n$ possesses the {\it rapid mixing} property, namely, the random walk mixes in time at most polynomially large in $\ln n$.

Structure identification of uncertain dynamical networks coupled with chaotic systems

傅新楚　　上海大学数学系

Topological structures and node dynamics of dynamical networks have important influence on their dynamical behaviours. In practical applications, not all of them can be well determined beforehand; therefore this talk investigates the structure identification of an uncertain dynamical network coupled with complex-variable chaotic systems. Based on the Barbalat's lemma, corresponding network estimators are designed for identifying the unknown or uncertain topological structure and node dynamics. Notably, the node dynamics need not to be identical and the topological structure need not to be symmetric or irreducible. Furthermore, this method can also better monitor the switching topological structure of a dynamical network. Numerical simulations are provided to verify the effectiveness of the theoretical results.

Some results on the critical group of a graph

陈海燕 集美大学　张福基 厦门大学

Let G be a connected graph. The critical group K(G) of G is a finite abelian group whose order is the tree-number of G. The critical group K(G) is a subtle isomorphism invariant of G, closely related to the cycle and bond spaces of the graph, the graph Laplacian , as well as the chip-firing game (or the abelian sandpile model) on the graph.   In this report, we concern about two aspects of a critical group. One is how to determine the order of an element in the critical group; the other is the relation between the critical group of a graph and that of its clique-inserted graph.

Nodal domain partition and the number of communities in networks

张晓东 上海交通大学

It is difficult to detect and evaluate the number of communities in complex networks, especially when the situation involves an ambiguous boundary between the inner- and inter-community densities. In this paper, discrete nodal domain theory is used to provide a criterion to determine how many communities a network has and how to partition these communities by means of topological structure and geometric characterization. By capturing the signs of the Laplacian eigenvectors, we separate the network into several reasonable clusters. The method leads to a fast and effective algorithm with application to a variety of real network data sets. （This work is jointed with Bian He and Lei Gu）

A sufficient and necessary condition which generates random graphs
with heavy tailed degree distribution
耿显民　南京航空航天大学

In our version of graph-valued stochastic processes, sample space is a set of all undirected simple graphs with countably many distinct nodes in which each individual has at most once choice at random from the existing graph at a fixed time, and the process' value is a graph. We investigate the statistical property of degree sequence and propose a sufficient and necessary condition for graph-valued processes to possess the power-law degree distribution. And then, the generating random graphs with heavy tailed degree distribution are deduced, while uniqueness and existence of the limiting degree distribution for the process are proved.

Social Network Marketing for Products with Negative Externalities
陈旭谨　中科院

With the fast development of social　network services, network marketing of products with externalities has been attracting more and more attention from both academia and business. The extensive study on network marketing mainly concerns with　positive externalities. The focus of this talk is on the much less understood counterpart for negative externalities, where a consumer has lower　incentive to buy a product as the product is possessed by more social network neighbors.

For a seller who markets these products, it is desirable to have a good schedule which specifies an order of consumers he approaches. We design polynomial time algorithms that find marketing schedules for products with negative externalities. The goals　are two-fold: maximizing the product sale and ensuring consumer regret-free decisions.　We show that the maximization is NP-hard. Our algorithms achieve satisfactory performance guarantees (approximating the maximum within constant factors), and provide regret-proof schedules (reaching an equilibrium state where no consumers regret　their previous decisions). We also study post pricing to enforce a purchase order instead of approaching consumers one by one.

Our work is the first attempt to address these social network marketing problems from an algorithmic point of view.　(Joint work with　Zhibin Cao and Changjun Wang.)

Limit Theorems for the Position of a Tagged Particle in the Stirring-Exclusion Process
章复熹　北京大学

Stirring-exclusion processes are exclusion processes with particles being stirred \cite{DFGW89}. We investigate a tagged particle among a Bernoulli product environment measure

on the lattice $\mathbb{Z}^d$. We show the strong law of large numbers and the central limit theorem for the tagged particle. The proof of the central limit theorem is based on the method of martingale decomposition with a sector condition \cite{KV86,Va95}.

带有表型转化机制的肿瘤干细胞模型
周达　厦门大学

我们讨论一种带有表型转化机制的肿瘤干细胞模型，它可看成一种推广的 Polya urn 模型。通过模型分析，我们发现在很宽泛的条件下，该模型几乎处处收敛到唯一的平稳点，由此解释了生物实验中普遍报到的"表型均衡"现象。另外，通过实验数据拟合，我们发现表型转化机制解释了肿瘤干细胞比例的"暂态激增"现象。

Metastable Densities for the Contact Process on Power Law Random Graphs
姚强　华东师范大学

We consider the contact process on a random graph with a fixed degree distribution given by a power law. We follow the work of Chatterjee and Durrett (2001), who showed that for arbitrarily small infection parameter λ, the survival time of the process is larger than a stretched exponential function of the number of vertices. For λ close to 0 (that is, "near criticality"), we obtain sharp bounds for the typical density of infected sites in the graph, as the number of vertices tends to infinity. We exhibit three different regimes for this density, depending on the tail of the degree law. (Joint work with Thomas Mountford and Daniel Valesin.)

Pointwise upper estimates for transition probability of continuous time random walks on graphs
陈新兴　上海交通大学

Let X be a continuous time random walk on a weighted graph. Given the on-diagonal upper bounds of transition probabilities at two vertices x_1 and x_2, we use an adapted metric initiated by Davies, and obtain Gaussian upper estimates for the off-diagonal transition probability $\P_{x_1}(X_t=x_2)$.

齐次图上的随机感染权重接触过程
薛晓峰　北京大学

给定图G，　G 上的随机感染权重接触过程是以${0，1}^G$ 为状态空间的自旋系统。运行机制如下，在每个结点x 赋独立同分布的非负随机感染权重$\rho(x)$。对任意结点x，　其状态从1 转移到0 的转移速率为1，　从0 转移到1 的转移速率 $\lambda\sum_{y: y\sim x}\rho(x)\rho(y)\eta(y)$。我们考虑任一族度递增的齐次图${G_n}_{n\ge 1}$ 以及其上的随机感染权重接触过程，　我们按照水动力极限的方式给出一种传染速率临界值λ_c的定义，并严格证明$\lambda_c\ge \frac{1}{E\rho^2}$ 。我们猜测在大多数较好的情形下，\frac{1}{E\rho^2}$就是临界值的准确值。

An Approach on Network Games
夏敏　上海交通大学

Some game models are proposed and the conditions for the existence of Nash equilibrium (NE)

in complex networks are obtained. Further, the evolution of large-scale network games are investigated. We mainly focus on two different cases: (i) the evolution follows joint strategy fictitious play (JSPF) process with inertia, and (ii) the evolution follows the log-linear learning. For the former, by the generalized ordinal potential game, we conclude that the action profiles of the network games converge to a pure NE almost surely. For the latter, by the potential game, we can obtain the stochastically stable state of the network games.

The limit density of connected components in a graph process

李彦 上海电力学院 上海交通大学

A dynamical graph process is presented to study a cluster aggregation network with epidemic on it. Each connected-component of the graph can be healthy or infected and the components can change their state or merge together according to specified rates. The existence and uniqueness of the limit density of connected components under certain hypothesis on the reaction rates are proved rigorously using the martingale approach. The gelation time of the process is also discussed in the mean-field approximation.

Epidemic spreading and global stability of an SIS model
with delay on heterogeneous networks

康慧燕博士： 上海大学

In this paper, we study an SIS model with delay on complex heterogeneous networks, which is more appropriate than ones without delays when a disease has an incubation period. We obtain the epidemic threshold of the SIS model and get some analytical results: When the infection rate is below the epidemic threshold, the infection continuously decreases until it dies out, that is, the disease-free equilibrium is globally asymptotically stable; while the infection rate is above the epidemic threshold, the infection continuously increases until it reaches a positive steady state, so the endemic equilibrium of the model is globally asymptotically stable.

Spectra of random graphs

袁炜罡 上海交通大学

Let $G(n,p)$ be a random subgraph of a complete graph where each edge appears randomly and independently with probability p. The largest eigenvalue of the the adjacency matrix of $G(n,p)$ is almost surely $\lambda_1(G)=(1+_O (1))max\{ \sqrt{\Delta} , np\}$, where the $_O(1)$ term tends to zero as max$\{ \sqrt{\Delta} , np\}$ tends to infinity.If we substitute the complete graph for a n-hypercube.The result doesn't change. Maybe this is a new way to treat the problem of spectra random graphs.

Bounded synchronization of stochastic multi-agent systems with nonidentical agents and time delays

董燕 上海交通大学

In this talk, we will study the bounded synchronization problem of networked multi-agent systems consisting of nonlinear nonidentical agent dynamics with stochastic noises and communication time delays. By using tools from differential equations and stochastic calculus, together with results

from matrix theory and algebraic graph theory, we will give sufficient conditions under which the considered system can achieve mean-square bounded synchronization. Note that, the obtained results contain an explicit formula for the maximal allowable upper bounds of communication delays, which need not to do a great deal of complex computation. Finally, we will demonstrate the effectiveness of the theoretical results by means of some numerical simulations.

Multiagent Net and Algebraic Connectivity

晋亚磊 上海交通大学

In this talk, we will introduce the agreement which is one of the fundamental problems in multiagent coordination, where a collection of agents are agree on a joint state value. There are some relation between agreement protocol and algebraic connectivity. In the graph theory, algebraic connectivity has been studied for many tears. At last, we will characterize which graphs has the maximal algebraic connectivity and minimal algebraic connectivity in the connected graphs with given clique number.