**The 3rd Workshop on**

# MARKOV PROCESSES AND RELATED TOPICS

August 10 - 14, 2004

**Center For International Academic Exchange (Room 1012A)**

**Beijing Normal University**

**Scientific Committee:**

Mu-Fa Chen, Zhi-Ming Ma, Zi-Kun Wang, Jia-An Yan

**Organizers:**

Mu-Fa Chen, Zeng-Hu Li, Feng-Yu Wang

Supported by National Natural Science Foundation of China(10121101)

---

**Probability Group, Research Center for Stochastics**

**School of Mathematical Sciences, Beijing Normal University**

No.19, Xinjiekouwai St., Beijing 100875, P. R. China

Phone and Fax: 86-10-58809447 E-mail: zhangyh@bnu.edu.cn

Website: http://math.bnu.edu.cn/probab/Workshop2004/index.html

# Schedule

| | August 10 | August 11 | August 12 | August 13 | August 14 |
|---|---|---|---|---|---|
| Chairman | Mu-Fa Chen | I. Shigekawa | Zhi-Ming Ma | Shi-Ge Peng | Min-Ping Qian |
| Speaker | I. Shigekawa<br>8:30–9:15 | Jia-An Yan<br>8:30–9:15 | Zhen-Ting Hou<br>8:30–9:15 | Zhi-Ming Ma<br>8:30–9:15 | Li-Ming Wu<br>8:30–9:15 |
| | Jin-Wen Chen<br>9:15–10:00 | Shi-Zan Fang<br>9:15–10:00 | An-Yue Chen<br>9:15–10:00 | T.S. Zhang<br>9:15–10:00 | Yao-Zhong Hu<br>9:15–10:00 |
| | Break | | | | |
| | W. Stannat<br>10:30–11:15 | Y. Lam<br>10:30–11:15 | Huo-Nan Lin<br>10:30–11:15 | Jie Xiong<br>10:30–11:15 | Xiang-Dong Li<br>10:30–11:15 |
| | H.Z. Zhao<br>11:15–12:00 | Song Liang<br>11:15–12:00 | Feng Wang<br>11:15–12:00 | Da-Yue Chen<br>11:15–12:00 | Xian-Yuan Wu<br>11:15–12:00 |
| Lunch | | | | | |
| Chairman | Jia-An Yan | Zhen-Ting Hou | | J.-D. Deuschel | |
| Speaker | G. Grimmett<br>14:00–14:45 | J.-D. Deuschel<br>14:00–14:45 | | Shi-Ge Peng<br>14:00–14:45 | |
| | Jiang-Lun Wu<br>14:45–15:30 | Zeng-Hu Li<br>14:45–15:30 | | S.J. Tang<br>14:45–15:30 | |
| | Break | | | | |
| | Y. Hariya<br>15:50–16:35 | Yong-Hua Mao<br>15:50–16:35 | | Yi-Jun Hu<br>15:50–16:35 | |
| | C.S. Wang<br>16:35–17:20 | Y.N. Sun<br>16:35–17:20 | | Elton P. Hsu<br>16:35–17:20 | |
| | Reception<br>(18:00-19:30) | | | | |

## August 10

08:30-09:15 I. Shigekawa (Kyoto University)

*Schrödinger operators on the Wiener space*

09:15-10:00 Jin-Wen Chen (Tsinghua University)

*Mixture of large deviation systems*

10:30-11:15 W. Stannat (Universität Bielefeld)

*On the stability of genetic algorithms - a variational approach*

11:15-12:00 H.Z, Zhao (Loughborough University)

*Generalized Itô formulae using local time and applications in analysing asymptotics of heat equations in the presence of caustics*

14:00-14:45 G. Grimmett (Churchill College, Cambridge)

*(Non-)uniqueness of random-cluster measures*

14:45-15:30 Jiang-Lun Wu (University of Wales Swansea)

*Fractal Burgers equation with stable white noise*

15:50-16:35 Y. Hariya (Kyoto University)

*Integration by parts formulae for the Wiener measure restricted to domains in* $\mathbb{R}^d$

16:35-17:20 C.S. Wang (Huazhong University of Science and Technology)

*$\delta$-Function of an Operator: A White Noise Approach*

## August 11

08:30-09:15 Jia-An Yan (Chinese Academy of Sciences)

*Mean-Risk Portfolio Selection Models in Continuous Time*

09:15-10:00 Shi-Zan Fang (University of Bourgogne)

*Analysis in free Riemannian path spaces*

10:30-11:15 Y. Lam (University of Hong Kong)

*Geometric Process*

11:15-12:00 Song Liang (Tohoku University)

*A Bounded Property for Gradients of Diffusion Semigroups on Euclidean Spaces*

14:00-14:45 J.-D. Deuschel (Technische Universität Berlin)

*Scaling limits of equilibrium wetting models in* $(1+1)$*-dimension*

14:45-15:30 Zeng-Hu Li (Beijing Normal University)

*On the regularity of affine Markov processes*

15:50-16:35 Yong-Hua Mao (Beijing Normal University)

*Strong ergodicity: some new results*

16:35-17:20 Y.N. Sun (National University of Singapore)

*Independent Random Matching and Markov Chains*

## August 12

| | |
|---|---|
| 08:30-09:15 | Zhen-Ting Hou (Central South University) |
| | *Markov skeleton processes and their applications* |
| 09:15-10:00 | An-Yue Chen (University of Greenwich) |
| | *From Markov Branching Processes to Collision Branching Processes* |
| 10:30-11:15 | Huo-Nan Lin (Fujian Normal University) |
| | *Some Multifractal Properties and the Local Phenomenon for Occupation Measure of Transient Brownian Sheet* |
| 11:15-12:00 | Feng Wang (Capital Normal University) |
| | *Quasi-factorization of $I_\alpha(f)$ and Latała-Oleszkiewicz's inquality for Gibbs random fields* |
| Afternoon | Break |

## August 13

08:30-09:15 Zhi-Ming Ma (Chinese Academy of Sciences)

*Reflected alpha-stable processes*

09:15-10:00 T.S. Zhang (University of Manchester)

*Perturbations of symmetric Markov processes*

10:30-11:15 Jie Xiong (University of Tennessee Knoxville)

*Mean-variance portfolio selection under partial information*

11:15-12:00 Da-Yue Chen (Peking University)

*The Reversible Nearest Particle System on a Finite Set*

14:00-14:45 Shi-Ge Peng (Shandong University)

*Filtration Consistent Nonlinear Expectations and Evaluations*

14:45-15:30 S.J. Tang (Fudan University)

*Characterization of Optimal Investment and Consumption by Backward Stochastic Parabolic Partial Differential Equations*

15:50-16:35 Yi-Jun Hu (Wuhan University)

*Asymptotic ruin probabilities for discrete time risk models with heavy-tailed claims*

16:35-17:20 Elton P. Hsu (Northwestern University)

*Characterizing Brownian Motion Through Integration by Parts*

## August 14

08:30-09:15 Li-Ming Wu (Université Blaise Pascal)

*On the uniqueness of Kolmogorov forward equations*

09:15-10:00 Yao-Zhong Hu (University of Kansas )

*Numerical Solution of Stochastic Delay Equation*

10:30-11:15 Xiang-Dong Li (Université Paul Sabatier)

*Liouvill theorem and Feller property for diffusion operator*

11:15-12:00 Xian-Yuan Wu (Capital Normal University)

*Edge-Negative Association in Random Spanning Forests and Connected Subgraphs on Connected Finite Graphs*

# ABSTRACT OF TALKS

### Schrödinger operators on the Wiener space

Ichiro SHIGEKAWA

Department of Mathematics, Graduate School of Science, Kyoto University, Kyoto, 606-8502, JAPAN

Abstract We consider a Schrödinger operator $-L+V$ on an abstract Wiener space $(B, H, \mu)$. Here $L$ is the Ornstein-Uhlenbeck operator and $V$ is a scalar potential. We discuss the following problems:

1. Essential self-adjointness of a Schrödinger operator.
2. The domain of the Schrödinger operator.
3. Spectral gap of the Schrödinger operator.

To solve the first problem, we use the logarithmic Sobolev inequality and the theory of positive generalized functions. For the second problem, we use the intertwining property of operators of the form $\sqrt{V}(-L+V) = A\sqrt{V}$. Here $A$ is a non-symmetric operator. For the third problem, we use the approximation method and show the norm convergence of associated resolvents. The uniform estimate of the Schrödinger operators plays an essential role.

### Mixture of large deviation systems

Jin-Wen Chen

Tsinghua University

Abstract Large deviation estimates for mixture of large deviation systems will be provided. Application to Laplace asymptotic integral will be illustrated.

**On the stability of genetic algorithms - a variational approach**

Wilhelm Stannat

Fakultät für Mathematik, Universität Bielefeld Postfach 100131 D-33501 Bielefeld Germany

Abstract We introduce a variational approach to study existence and uniqueness of stationary states and stability of evolution equations governing the evolution of empirical measures of genetic algorithms (with possibly interactive selection) in the limit of a large number of individuals. The variational approach leads to a new interpretation of the rate of convergence of the underlying algorithms. Applications to the simulation of ground states, stochastic optimization algorithms and to filtering theory are discussed.

**References:**

[1] W. Stannat, On the convergence of genetic algorithms - a variational approach, Probab. Theory Relat. Fields, Vol. 129, 113-132, 2004.

[2] W. Stannat, On the stability of time-dependent genetic algorithms, Bielefeld 2004, submitted.

[3] W. Stannat, Stability of the pathwise filter equation on $\mathbb{R}^d$, Bielefeld 2004.

**Generalized Itô formulae using local time and applications in analysing asymptotics of heat equations in the presence of caustics**

Huai-Zhong Zhao

Department of Mathematical Sciences, Loughborough University

Abstract I will first present a new generalized Ito formula for $f(t,x)$ using the two-dimensional Lebesgue-Stieltjes integral of local time with respect to $\frac{\partial^-}{\partial t} f(t,x)$ of locally bounded variation in $(t,x)$. I will discuss the application of the formula e.g. to the stochastic elementary formula and asymptotics of heat equation in the presence of caustic. Finally I will discuss the extension to

multi-dimensions and define the stochastic Lebesgue-Stieltjes integral $\int_{-\infty}^{\infty}\int_0^t f(s,a)d_{s,a}h(s,a)$. Here $s \mapsto h(s,a)$ is a continuous martingale and $\langle h(a), h(b)\rangle_s$ is of locally bounded variation in $(a,b)$.

The talk is based on the following articles:


[1] K.D. Elworthy, A. Truman and H.Z. Zhao, Generalized Itô formulae and Space-Time Lebesgue-Stieltjes Integrals of Local times.

[2] K.D. Elworthy, A. Truman and H.Z. Zhao, Asymptotics of heat equations with caustics in one-dimension.

[3] C.R. Feng and H.Z. Zhao, A generalized Itô formula in two-dimensions and stochastic Lebesgue-Stieltjes integrals.


### (Non-)uniqueness of random-cluster measures


G. Grimmett

Churchill College, Cambridge



Abstract The random-cluster model is a generalisation of percolation, and it provides a basic method for studying models for ferromagnetism including Ising and Potts models. One of the main questions is to determine conditions under which there exists a unique random-cluster measure. This problem will be discussed for lattices and trees, and new results of the speaker and Svante Janson will be included.


### Fractal Burgers equation with stable white noise


Jiang-Lun Wu

Department of Mathematics, University of Wales Swansea, UK

Abstract In this talk, we consider the following fractal Burgers equation forced by stable space-time white noise

$$(\partial_t - \nu\Delta_\alpha)u + \lambda\partial_x(|u|^r) = \gamma|u|^\beta M_{t,x}, \quad (t,x) \in (0,\infty)\times\mathbf{R}$$

where $\nu, \lambda, r, \gamma, \beta$ are positive constants, $\Delta_\alpha := -(-\frac{d^2}{dx^2})^{\frac{\alpha}{2}}$ is the fractional Laplacian on $\mathbf{R}$ with $\alpha \in (0,2)$, and $M_{t,x}$ is $p$-stable space-time white noise with $p \in (0,2)$. We discuss mainly the existence of a weak solution (as a superprocess) to the initial problem for this equaiton. The talk is based on a recent joint work with Aubrey Truman.

## Integration by parts formulae for the Wiener measure restricted to domains in $\mathbb{R}^d$

Yuu Hariya

Research Institute for Mathematical Sciences, Kyoto University

Sakyo-ku, Kyoto 606-8502 Japan

Abstract In [2], Zambotti explored an integration by parts formula for the pinned Wiener measure over a time interval $[0,1]$ restricted to the path space $D = C([0,1];\Omega)$, where $\Omega = (0,\infty) \subset \mathbb{R}$. It is pointed out that, similarly to the divergence theorem in finite dimension, there appears a certain boundary term in the formula, which is explicitly expressed in terms of pinned 3-dimensional Bessel processes.

In this talk, we shall discuss an extension of his result to the case of general $\Omega's$ in $\mathbb{R}^d$: Let $\Omega$ be an open region in $\mathbb{R}^d$. For $a, b \in \Omega$, let $B$ and $\hat{B}$ be independent $d$-dimensional Brownian motions starting respectively at $a$ and $b$. Let $\tau_\Omega(\hat{B})$ (resp. $\tau_\Omega(\hat{B})$) be the first exist time from $\Omega$ of $B$ (resp. of $\hat{B}$). Given $\tau_\Omega(B) + \tau_\Omega(\hat{B}) = 1, B_{\tau_\Omega(B)} = x$, and $\hat{B}_{\tau_\Omega(\hat{B})} = x$, define the process $Y = (Y_t)_{0\le t\le 1}$ by

$$Y_t = \begin{cases} B_t, & 0 \le t \le \tau_\Omega(B), \\ \hat{B}_{\tau_\Omega(B)+\tau_\Omega(\hat{B})-t}, & \tau_\Omega(B) \le t \le \tau_\Omega(B) + \tau_\Omega(\hat{B}). \end{cases}$$

Let $\mathbb{P}_{a,x,b}$ denote the law of $Y$ and $\mathbb{E}_{a,x,b}$ the expectation with respect to $\mathbb{P}_{a,x,b}$. For an element $\omega$ in the support of $\mathbb{P}_{a,x,b}$, let $S_x(\omega) \in (0,1)$ be the time at which $\omega(S_x(\omega)) = x$. Let $H_\Omega$ be the minus one half of the Dirichlet Laplacian for $\Omega$, and $e^{-tH_\Omega}(y,z)$ the integral kernel

of the semigroup $e^{-tH_\Omega}$ generated by $H_\Omega$. For the pinned Wiener measure $\mathcal{W}^{a,b}_{[0,1]}$ over $[0,1]$ with boundary conditions $a, b$ at each end, we may prove the following formula under a certain condition on $\Omega$: for a smooth functional $F$, and for $h = (h_i)_{1\le i\le d}, h_i \in C_0^\infty((0,1))$,

$$\int_D \partial_h F(\omega)\mathrm{d}\mathcal{W}^{a,b}_{[0,1]}(\omega) = -\int_D F(\omega)\sum_{i=1}^d \int_0^1 h_i''(s)\omega_i(s)\mathrm{d}s\mathrm{d}\mathcal{W}^{a,b}_{[0,1]}(\omega) + (\textit{boundary term}),$$

where the boundary term is given by

$$-\sqrt{2^{d-2}\pi^d}e^{|a-b|^2/2}\int_{\partial\Omega}\sigma(\mathrm{d}x)\mathbb{E}_{a,x,b}[\mathbf{n}_x\cdot h(S_x)F]\times\int_0^1 \mathrm{d}u\frac{\partial}{\partial\mathbf{n}_x}e^{-uH_\Omega}(a,x)\frac{\partial}{\partial\mathbf{n}_x}e^{-(1-u)}H_\Omega(b,x).$$

Here $\sigma$ denotes the surface measure on the boundary $\partial\Omega$, $\mathbf{n}_x$ denotes the inward normal vector at $x\in\partial\Omega$, and $\partial/\partial\mathbf{N}_x$ denotes the normal derivative at $x$.

This formula may be used to construct Funaki strings [1] moving in $\Omega$ with the help of the Dirichlet form theory.


[1] Funaki, T.: Random motion of strings and related stochastic evolution equations. Nagoya Math. J. **89**, 129-193 (1983).

[2] Zambotti, L.: Integration by parts formulae on convex sets of paths and applications to SPDEs with reflection. Probab. Theory Relat. Fields **123**, 579-600 (2002).


## $\delta$-Function of an Operator: A White Noise Approach


Cai-Shi Wang and Zhi-Yuan Huang

Department of Mathematics, Huazhong University of Science & Technology

Wuhan, Hubei 430074, P. R. China



Abstract Let $(E)\subset(L^2)\subset(E)^*$ be the canonical framework of white noise analysis over the Gel'fand triple $S(\mathbb{R})\subset L^2(\mathbb{R})\subset S^*(\mathbb{R})$ and $\mathcal{L}\equiv\mathcal{L}[(E),(E)^*]$ be the space of continuous linear operators from $(E)$ to $(E)^*$. Let $Q$ be a self-adjoint operator in $(L^2)$ with spectral representation $Q=\int_{\mathbb{R}}\lambda P_Q(\mathrm{d}\lambda)$. In this paper, it is proved that under appropriate conditions upon $Q$, there exists a unique linear mapping $Z: S^*(\mathbb{R})\mapsto\mathcal{L}$ such that $Z(f)=\int_{\mathbb{R}}f(\lambda)P_Q(\mathrm{d}\lambda)$ for each

$f \in S(\mathbb{R})$. The mapping is then naturally used to define $\delta(Q)$ as $Z(\delta)$, where $\delta$ is the Dirac $\delta$-function. Finally properties of the mapping $Z$ are investigated and several results are obtained.

### Mean-Risk Portfolio Selection Models in Continuous Time

Jia-An Yan

Chinese Academy of Sciences

(This is a joint work with H. Jin and X. Zhou of Chinese University of Hong Kong)

Abstract This paper is concerned with continuous-time portfolio selection models where the objective is to minimize the risk subject to a prescribed expected payoff at the terminal time. The risk is measured by the expectation of a certain function of the deviation of the terminal payoff from its mean. First of all, a model where the risk has different weights on the upside and downside variance is solved explicitly. The limit of this weighted mean—variance problem, as the weight on the upside variance goes to zero, is the mean–semivariance model which is shown to admit *no* optimal solution. This negative result is further generalized to a mean– downside-risk portfolio selection problem where the risk has non-zero value only when the terminal payoff is lower than its mean. Finally, a general model is investigated where the risk function is convex. Sufficient and necessary conditions for the existence of optimal portfolios are given. Moreover, when the existence is assured, optimal solutions are obtained.

### Geometric Process

Yeh LAM

Department od Statistics and Actuarial Science, The University of Hong Kong, Hong Kong

Northeastern University at Qinhuangdao, 066004, China

Abstract Geometric process (GP) was introduced by Lam(1988a,b) as a generalization of renewal processes. A stochastic process $\{X_n, n = 1, 2, \cdots\}$ is called a GP if the exists a real number $a > 0$, such that $a^{n-1}X_n, n = 1, 2, \cdots\}$ forms a renewal processes. In this talk, we shall study the probability properties of GP, including the limit theorems in GP and the Wald

equation in GP. Furthermore, a function $M(t,a)$ is defined as the expected number of events ocuurred by time t in the GP. The existence and the properties of function $M(t,a)$ are then considered.

### A Bounded Property for Gradients of Diffusion Semigroups on Euclidean Spaces

Song LIANG

Graduate School of Information Sciences, Tohoku University, Japan

Abstract Consider the stochastic differential equation (SDE) on Euclidean space $\mathbb{R}^d$ given by

$$\begin{cases} \mathrm{d}X^i(t,x) = \sum_{j=1}^d \sigma_{ij}(X(t,x))\mathrm{d}B_t^j + b_i(X(t,x))\mathrm{d}t, \quad i = 1, \cdots, d, \\ X(0,x) = x, \end{cases} \tag{1}$$

where $(B_t^1, \cdots, B_t^d)$ is a $d$-dimensional Brownian motion. We assume that all of the coefficients are smooth, and that the diffusion term is uniformly elliptic. Under some conditions with respect to the drift term $b = (b_1, \cdots, b_d)$, we give a non-uniform estimate of $\nabla P_t f$, with the power of $1/t$ smaller than1. Here $P_t$ is the operator given by $P_t f(x) = E[f(X_t)]$. More precisely, we show that for any $\alpha \geq 0$ and $\beta > 0$, there exists constants $d_\beta \in (0,1)$ and $C_{\alpha,\beta} > 0$ such that

$$|\nabla P_t f(x)| \leq (1+|x|^2)^\gamma \frac{C_{\alpha,\beta}}{t^{d_\beta}} \|(1+|\cdot|^2)^{-\frac{\alpha}{2}} f\|_\infty$$

for any $t \in (0,1], x \in \mathbb{R}^d$ and $f \in C(\mathbb{R}^d)$ satisfying $(1+|\cdot|^2)^{-\frac{\alpha}{2}} f \in C_b(\mathbb{R}^d)$. Here $\gamma$ is a constant depending on $b$.

### Scaling limits of equilibrium wetting models in $(1+1)$-dimension

J. D. Deuschel, G. Giacomin and L. Zambotti

Abstract We study the path properties for the $\delta$-pinning wetting model in $(1+1)$-dimension. In other terms, we study a random walk model with fairly general continuous increments conditioned to stay in the upper half plane and with a $\delta$-measure reward for touching zero, that is the boundary of the forbidden region. It is well known that such a model displays a localization/delocalization transition, according to the size of the reward. Our focus is on getting

a precise pathwise description of the system, in both the delocalized phase, that includes the critical case, and in the localized one. From this we extract the (Brownian) scaling limits of the model.

### On the regularity of affine Markov processes

Zeng-Hu Li

Beijing Normal University

Abstract The concept of affine processes unifies a wide class of Markov processes including Ornstein-Uhlenbeck processes and continuous state branching processes with immigration. Those processes involve rich common mathematical structures and the unification of them develops interesting connections between several areas in the theory of probability. The "affine property" is roughly that the logarithm of the characteristic function of the transition semigroup is given by an affine transformation of the initial sate. A complete characterization of affine processes was given by Duffie et al (Ann. Appl. Probab., 2003) under a regularity assumption, which requires that the coefficients in the affine relationship are differentiable. Based on this characterization, Duffie et al (2003) discussed a wide range of applications of affine processes as interest rate models. In this work, we formulate the general affine Markov semigroup as the convolution of a homogeneous one with a skew convolution semigroup. Under some conditions on the first moments, we establish the regularities of the homogeneous affine semigroup and the skew convolution semigroup. These give a partial solution of a problem of Duffie et al (2003).

### Strong ergodicity: some new results

Yong-Hua Mao

Beijing Normal University

Abstract In this talk, we review some new results related to strong ergodicity, which include the estimates fo the convergence rate in strong ergodicity, explicit formulas for discrete spectrum in

$L^\infty$. Some applications are given to concrete processes such as branching processes and random walks on the trees.

### Independent Random Matching and Markov Chains

Darrell Duffie (Stanford University) and Yeneng Sun* (National University of Singapore)

Abstract We provide micro-foundations for independent random matching of a large population, as widely used in the economics and genetics literatures. We consider both static and dynamic systems with random mutation, partial matching arising from search, and type changes induced by matching. Under independence assumptions at each randomization step, we show that there is an almost-sure constant cross-sectional distribution of types in a large population, and moreover that the time evolution of the cross-sectional type process is completely determined from a Markov chain with known transition matrices. We also construct a joint agent-probability space, and randomized mutation, partial matching, and match-induced type-changing functions that satisfy the required independence conditions.

### Markov skeleton processes and their applications

Zhen-Ting Hou

Central South University

Abstract A stochastic process $X(t)$ is called a Markov skeleton process(MSP) if it has the Markov property on a sequence of stopping times. The usual Markov process, semi-Markov process, deterministic Markov process and semi-regenerative process can be regarded as special cases of MSP. In this paper, first, backward and forward equations with which we can compute one-dimensional distribution is derived, and then formulas to compute finite-dimensional distribution and the existence and computation of limit distribution are also obtained. Based ourselves upon the above the results, we give a tentative study of queueing system, reliability system, and storage system. Transient distribution and formulas to compute limit distribution of the stochastic processes introduced for studying these system are presented in the latter half the paper.

**From Markov Branching Processes to Collision Branching Processes**

An-Yue Chen

University of Greenwich

Abstract This talk focuses on addressing some basic properties of two new models, the Weighted Markov Branching Process (WMBP) and the Collision Branching Processes (CBP). The emphasis will be put upon the methodological aspect, particularly the powerful random time change technique.

WMBP is a natural generalisation of the ordinary Markov Branching Process (MBP). Two approaches, the analytic as well as the probabilistic approaches, in tackling such process are explained in detail. First, using the analytic method particularly the recently developed Generalised Reuter Lemma, the regularity and uniqueness criteria, which are very easy to verify, are established. The extinction probability of such structure is obtained. The closed forms for the mean extinction time and the conditional mean extinction time are presented. The explosion behaviour is also investigated and the mean explosion time is derived. Then the probabilistic approaches, in particular, the technique of random time changes and the Lamperti Transforms are used to tackle these models. Using such methods, the deep relationship between these newly developed processes and the well-known compound Poisson processes is revealed. It is proved that any Weighted Markov Branching Process can be viewed as a random time change of a compound Poisson process. As a consequence, most of results obtained by analytic method can be regained using these probabilistic approaches.

The second new branching model, the Collision Branching Process (CBP), differs from the traditional branching model in that branching events are effected by the interaction/collision of pairs of particles, rather than by the particles individually. This new model allows one to study the effect of collision, or interaction, between particles or individuals and thus can be used outside the present context. We illustrate that some new interesting questions are arisen from such models. A particular interesting problem is that, different from the ordinary branching structure, there exist two absorbing states and hence it is necessary to evaluated probabilities of absorbing for these states individually. The regularity and uniqueness criteria are also firstly established. The explicit expressions are obtained for the extinction and explosion probabilities,

as well as the associated expected hitting times. The likelihood of using the similar probabilistic approach as in WMBP for these models is also highlighted.

**Some Multifractal Properties and the Local Phenomenon for Occupation Measure of Transient Brownian Sheet**

Huo-Nan Lin

Fujian Normal University

Abstract The localization phenomenon of occupation time for transient Brownain sheet is dicussed.We obtain the localization phenomenon and its applications in asymptotic laws and mutltifractal decomposition for Occupation Measure of Transient Brownian Sheet. Because of the partially-ordered nature in the multi-parameter index space , we can't determine the accurate constants as well as Brownian motion's.

**Quasi-factorization of $I_\alpha(f)$ and Latała-Oleszkiewicz's inquality for Gibbs random fields**

Feng Wang

Mathematical Department, Capital Normal University

Abstract We show $I_\alpha(f)$ exhibits a quasi-factorization property with respect to a pair of weakly dependent $\sigma$-algebras. As an application under uniform mixing condition , Gibbs specification with translation invariantand and finite range summable interaction has uniform Latała-Oleszkiewicz's ineqalities.

**Reflected alpha-stable processes**

Zhi-Ming Ma

Chinese Academy of Sciences

(The talk is based on my joint work with Q.Y.Guan and with Z.C.Hu respectively)

Abstract In recent years there has been an increasing interest in the study of non-Gaussian Levy processes which are now widely used in physics, operations research, queuing theory, mathematical finance, risk estimation, and others. In this talk I shall present some new results concerning a class of reflected non-Gaussian Levy processes–reflected alpha stable processes. We show that the generators of the reflected alpha-stable processes are regional fractional Laplacian which we described as a class of integral operators. We obtained integral by parts formula for regional fractional Laplacian which serves as the Gauss-Green formula for the classical Laplacian. We obtained also the semi-martingale decomposition of reflected alpha astable processes which will be particularly useful in the study of stochastic integrals driven by discontinuous reflected Levy processes. I shall also present an extension of Levy-Khinchine formula which will be available for a wide class of Dirichlet processes on general state spaces.

**Perturbations of symmetric Markov processes**

Tu-Sheng Zhang

Abstract In this talk I will discuss lower order perturbations of symmetric Markov processes and probabilistic representations of the associated semigroups.

**The Reversible Nearest Particle System on a Finite Set**

Dayue Chen, Juxin Liu and Fuxi Zhang

School of Mathematical Sciences, Peking University, Beijing 100871, China

Abstract We study the one-parameter family of attractive reversible nearest particle systems on $\{1, 2, \cdots, N\}$. Denote by $\sigma_N$ the time that the system first hits the empty set. Then, $\sigma_N$ has a logarithmic increasing rate as the parameter $\lambda$ is small enough, but an exponential increasing rate as $\lambda$ is large enough. Especially, it has a polynomial increasing rate in the critical case, i.e. $\lambda = 1$.

**Characterization of Optimal Investment and Consumption by Backward Stochastic Parabolic Partial Differential Equations**

Shan-Jian Tang

Fudan University

ABSTRACT An optimal investment and consumption problem is considered without assumption of Markov asset prices. The optimal investment and consumption is characterized by backward stochastic parabolic partial differential equations. The relevant backward stochastic HJB equation is also studied.

**Asymptotic ruin probabilities for discrete time risk models with heavy-tailed claims**

Xiao Wei and Yi-Jun Hu

School of Mathematics and Statistics, Wuhan University

ABSTRACT Consider a discrete time risk model $U_n = (U_{n-1} + X_n)(1 + I_n) - Y_n$, $n = 1, 2, \cdots$, where $U_0 := M > 0$ is the initial reserve of an insurance company, $X_n$ the total amount of premiums, $Y_n$ the total amount of claims, $I_n$ the interest rate and $U_n$ the reserve at time $n$. Define the time of ruin by $\tau_M := \inf\{n \geq 1; U_n < 0\}$. Assume that $\{Y_n\}$ are heavy-tailed. Our main objective is to give reasons for the asymptotic estimate $P(\tau_M < \infty) \approx M^{-\lambda}$ where $\lambda$ is a specific positive parameter. A more general risk model from Nyrhinen (1999) is also discussed, and similar asymptotic estimate for ruin probabilities is given.

**On the uniqueness of Kolmogorov forward equations**

Li-Ming Wu

ABSTRACT We study the notion of several uniqueness on the space of bounded and measurable functions. The relations with nonnegative uniqueness, Q-uniqueness, Markov uniqueness and martingale uniqueness are established. A quite complete picture is given for jumps processes (especially birth-death processes), and for one-dimensional Schrodinger operators.

**Numerical Solution of Stochastic Delay Equation**

Yao-Zhong Hu

University of Kansas

Abstract we develop a strong Milstein approximation scheme for solving stochastic delay differential equations (SDDE's). The scheme has convergence order 1. In order to establish the scheme, we prove an infinite-dimensional Ito formula for "tame" functions acting on the segment process of the solution of an SDDE. It is interesting to note that the presence of the memory in the SDDE requires the use of the Malliavin calculus and the anticipating stochastic analysis of Nualart and Pardoux. Given the non-anticipating nature of the SDDE, the use of anticipating calculus methods in the context of strong approximation schemes appears to be novel.

**Edge-Negative Association in Random Spanning Forests and Connected Subgraphs on Connected Finite Graphs**

Xian-Yuan Wu

Capital Normal University

Abstract Let $G$ be a connected finite graph. We consider three types of probability measures on $\mathcal{G}$, the set of subgraphs of $G$, which govern a random spanning tree, a random spanning forest, and a random connected subgraph respectively. Based on the edge-negative association in uniform spanning tree, we construct a family of random spanning forests and random connected subgraphs on $G$ which are edge-negative associated.

## List of Participants

| **Name** | **Email** | **University/Institute** |
|---|---|---|
| An-Yue Chen | A.Chen@gre.ac.uk | University of Greenwich |
| Da-Yue Chen | dayue@pku.edu.cn | Peking University |
| Jin-Wen Chen | jchen@math.tsinghua.edu.cn | Tsinghua University |
| Mu-Fa Chen | mfchen@bnu.edu.cn | Beijing Normal University |
| Jean-Dominique Deuschel | deuschel@math.TU-Berlin.DE | Technische Universität Berlin |
| Shi-Zan Fang | fang@u-bourgogne.fr | University of Bourgogne |
| Fu-Qing Gao | gaofq@public.wh.hb.cn | Wuhan University |
| Geoffrey Grimmett | G.R.Grimmett@statslab.cam.ac.uk | Churchill College, Cambridge |
| Yuu Hariya | hariya@kurims.kyoto-u.ac.jp | Kyoto University |
| Wen-Ming Hong | wmhong@bnu.edu.cn | Beijing Normal University |
| Elton P. Hsu | elton@math.northwestern.edu | Northwestern University |
| Yao-Zhong Hu | hu@math.ukans.edu | University of Kansas |
| Yi-Jun Hu | yijunhu@public.wh.hb.cn | Wuhan University |
| Zhen-Ting Hou | zthou@csu.edu.cn | Central South University |
| Da-Quan Jiang | jiangdq@math.pku.edu.cn | Peking University |
| Yeh Lam | ylam@hkustasc.hku.hk | University of Hong Kong |
| Bo Li | haoyoulibo@163.com | Huazhong Normal University |
| Xiang-Dong Li | xiang@cict.fr | Université Paul Sabatier |
| Zeng-Hu Li | lizh@bnu.edu.cn | Beijing Normal University |
| Song Liang | liang@math.is.tohoku.ac.jp | Tohoku University |
| Huo-Nan Lin | linhn@fjnu.edu.cn | Fujian Normal University |
| Xiang Lin | | Central South University |
| Yuan-Yuan Liu | | Central South University |
| Jiao-Wan Luo | | Central South University |
| Zhi-Ming Ma | mazm@mail.amt.ac.cn | Chinese Academy of Sciences |
| Yong-Hua Mao | maoyh@bnu.edu.cn | Beijing Normal University |

| | | |
|---|---|---|
| Shi-Ge Peng | peng@math.sdu.edu.cn | Shandong University |
| Ichiro Shigekawa | ichiro@math.kyoto-u.ac.jp | Kyoto University |
| Wilhelm Stannat | stannat@Mathematik.Uni-Bielefeld.DE | Universität Bielefeld |
| Ye-Neng Sun | imssuny@nus.edu.sg | National University of Singapore |
| Shan-Jian Tang | sjtangk@online.sh.cn | Fudan University |
| Cai-Shi Wang | wangcs@nwnu.edu.cn | Huazhong Univ. of Science & Tech. |
| Feng Wang | wangf@mail.cnu.edu.cn | Capital Normal University |
| Hong Wang | | Central South University |
| Ying-Zhe Wang | wangyingzhe0721@sina.com | Beijing Normal University |
| Zi-Kun Wang | wangzk@bnu.edu.cn | Beijing Normal University |
| Jiang-Lun Wu | J.L.Wu@swansea.ac.uk | University of Wales Swansea |
| Li-Ming Wu | Li-Ming.Wu@math.univ-bpclermont.fr | Université Blaise Pascal |
| Xian-Yuan Wu | wuxy@mail.cnu.edu.cn | Capital Normal University |
| Jie Xiong | jxiong@math.utk.edu | University of Tennessee Knoxville |
| Guo-Jun Yan | | Central South University |
| Jia-An Yan | jayan@mail.amt.ac.cn | Chinese Academy of Sciences |
| Tu-Sheng Zhang | tzhang@maths.man.ac.uk | Manchester University |
| Mei Zhang | meizhang@bnu.edu.cn | Beijing Normal University |
| Yu-Hui Zhang | zhangyh@bnu.edu.cn | Beijing Normal University |
| Huai-Zhong Zhao | H.Zhao@lboro.ac.uk | Loughborough University |
| Jie Dai | | Peking University |
| Yong Liu | | Peking University |
| Li Wei | | Chinese Academy of Sciences |
| Lei Zhao | | Chinese Academy of Sciences |
| Wen-Sheng Wang | | Chinese Academy of Sciences |
| Fu-Zhou Gong | | Chinese Academy of Sciences |
| Qing-Yang Guan | | Chinese Academy of Sciences |
| Fu-Xi Zhang | | Peking University |
| Shui-Cao Zheng | | Peking University |

| | | |
|---|---|---|
| Guan-Tie Deng | | Beijing Normal University |
| Zong-Fei Fu | | Renming University of China |
| Kai-Nan Xiang | | Hunan Normal University |
| Min-Ping Qian | | Peking University |

GRADUATE STUDENT

| | | |
|---|---|---|
| Zheng-Liang Zhang | | Wuhan University |
| Qiong-Xia Song | | Wuhan University |
| Chen-Jia Yu | cauchy_xd@sjtu.edu.cn | Shanghai Jiao Tong University |
| Yun Xue | | Fujian Normal University |
| Wen-Hua Gao | | Peking University |
| He Li | | Peking University |
| Jing-Xiao Zhang | | Chinese Academy of Sciences |
| Jian Wang | | Fujian Normal University |
| Bo Zhou | | Loughborough University |
| Chuan-Zhong Chen | | Hainan Normal University |
| Ping-Ji Deng | dengpj@etang.com | Beijing Normal University |
| Jing-Hai Shao | jing_hai_sh@sohu.com | Beijing Normal University |
| Shunxiang Ouyang | ouyangshx@etang.com | Beijing Normal University |
| Bo Wu | | Beijing Normal University |
| Li-Hua Zhang | zhanglh@mail.bnu.edu.cn | Beijing Normal University |
| Hao Cui | | Beijing Normal University |
| Yun-Jun Song | songyunjun@sohu.com | Beijing Normal University |
| Qian-Qian Zhao | happy_carol@163.com | Beijing Normal University |
| Yu-Lan Zhou | zhouyulan@sohu.com | Beijing Normal University |
| De-Jun Luo | luoluohe@126.com | Beijing Normal University |
| Liang-Li Bi | biliangli2003@mail.bnu.edu.cn | Beijing Normal University |
| He-Yan Jin | jinheyan@mail.bnu.edu.cn | Beijing Normal University |
| Guang-Qiang Lan | lgq.001@mail.bnu.du.cn | Beijing Normal University |
| Yan-Xia Liu | liuyanxiaxia@163.net | Beijing Normal University |

| | | |
|---|---|---|
| Li Tian | tcltian@sohu.com | Beijing Normal University |
| Ze-Shan Jiang | jzsjohnson@mail.bnu.edu.cn | Beijing Normal University |
| Hao Jiang | | Beijing Normal University |
| Shoufeng Shao | | Beijing Normal University |
| Fang-Cheng Hao | haofangcheng@mail.bnu.edu.cn | Beijing Normal University |
| Qing-Hui Zhang | zhqh@mail.bnu.edu.cn | Beijing Normal University |