The 5th Workshop on Markov Processes and Related Topics

July 14 - 18, 2007

Jingshi Building, Beijing Normal University

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Schedule

July 14:

Chairman: Mu-Fa Chen

08:30–08:40	Opening (Speech by Mu-Fa Chen)
08:40–09:30	Masatoshi Fukushima
09:30–10:00	Tea break, and take picture
10:00–10:30	Zhenqing Chen
10:30–11:00	Panki Kim
11:00–11:30	Jinghai Shao
11:30–13:00	Lunch

Chairman: Fengyu Wang

14:30–15:00	Chii-Ruey Hwang
15:00–15:30	Ivan Gentil
15:30–16:00	Tea break
16:00–16:30	Fuzhou Gong
16:30–17:00	Brice Franke
17:00–17:30	Yutao Ma
17:20–	Dinner

July 15:

Chairman: Fuzhou Gong

08:30–09:00	Shuenn-Jyi Sheu
09:00–09:30	Fengyu Wang
09:30–10:00	Tea break
10:00–10:30	Renming Song
10:30–11:00	Christian Leonard
11:00–11:20	Xu Zhang
11:30–13:00	Lunch

Chairman: Shizan Fang

14:30–15:00	Tusheng Zhang
15:00–15:30	Xiang-Dong Li
15:30–16:00	Tea break
16:00–16:30	Jinwen Chen
16:30–17:00	Qingyang Guan
17:00–17:30	Xin Qi
17:20–	Dinner

July 16

Chairman: Shui Feng

08:30–09:00	Anyue Chen
09:00–09:30	Jiashan Tang
09:30–10:00	Tea break
10:00–10:30	Xia Chen
10:30–11:00	Yonghua Mao
11:00–11:20	Dejun Luo
11:30–13:00	Lunch

July 17:

Chairman: Jie Xiong

08:30–09:00 Leonid Mytnik
09:00–09:30 Quansheng Liu
09:30–10:00 Tea break, and take picture
10:00–10:30 Hao Wang
10:30–11:00 Xiaowen Zhou
11:00–11:20 Hui He
11:30–13:00 Lunch

Chairman: Zengjing Chen

14:30–15:00 Dayue Chen
15:00–15:30 Alok Goswami
15:30–16:00 Tea break
16:00–16:30 Fuqing Gao
16:30–17:00 Xian-Yuan Wu
17:00–17:30 Dapeng Zhan
17:30– Banquet

July 18:

Chairman: Dayue Chen

08:30–09:00 Zengjing Chen
09:00–09:30 Dong Han
09:30–10:00 Tea break
10:00–10:30 Zongxia Liang
10:30–11:00 Fubao Xi
11:00–11:20 Liqun Niu
11:30–13:00 Lunch

Chairman: Zenghu Li

14:30–15:00 Shizan Fang
15:00–15:30 Yimin Xiao
15:30–16:00 Tea break
16:00–16:30 Shui Feng
16:30–17:00 Jie Xiong
17:00–17:20 Chunhua Ma
17:20– Dinner

Abstract

DECAY PROPERTIES OF MARKOVIAN QUEUES WITH BATCH ARRIVALS

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KEY WORDS: Decay parameter; Invariant measures; Quasi-stationary distributions; Markovian bulk-arriving queues.

MATHEMATICAL SUBJECT CLASSIFICATION: 60J27

Abstract: We consider the decay parameter, invariant measures and quasi-stationary distributions for a modified queueing model which stops when the queueing system is empty. Investigating such model is crucial in realizing the busy period and some other related properties of the Markovian bulk-arriving queue. In this paper, the exact value of the decay parameter λ_C of such model is obtained. We show that it can be easily expressed explicitly. The invariant measures and quasi-distributions of such processes are then considered. We show that there exists a family of invariant measures indexed by $\lambda \in [0, \lambda_C]$. We then show that under some conditions, there exists a family of, also indexed by $\lambda \in [0, \lambda_C]$, quasi-stationary distributions.The generating functions of these invariant measures and quasi-stationary distributions are presented. We further show that this modified queueing model is always λ_C-transient and some deep properties are revealed. The clear geometric interpretation of the decay parameter is explained. A few examples are then provided to illustrate the results obtained in this paper.

SOME OPEN PROBLEMS OF PERCOLATION AND THE CONTACT PROCESS ON GRAPHS

Dayue CHEN *Peking University, China.* E-mail: dayue@math.pku.edu.cn

KEY WORDS: contact process, percolation, graph.

Abstract: Recent studies of percolation and interacting particle systems have gone beyond Z^d and many challenging problems emerge. I will discuss some open problems in which I am interested.

NONERGODICITY OF MARKOV PROCESSES

Jinwen CHEN *Tsinghua University, China.* E-mail: jchen@math.tsinghua.edu.cn

Abstract: Detecting nonergodicity of certain Markov processes from the perspective of large deviations will be discussed.

HIGH MOMENT ASYMPTOTICS FOR LOCAL AND INTERSECTION INTERSECTION LOCAL TIMES

Xia CHEN *University of Tennessee, USA.* E-mail: xchen@math.utk.edu

Abstract: Moment method has been used to establish the weak convergence amon the local and intersection local times since the remarkable work by Darling and Kac (1957). In this case the power of the moment is often fixed. However, much less has been explored on the high moment asymptotics, where the power of the moment tends to infinity. The study in this direction is motivated by the needs in investigation large deviations. In this talk, I will speak on some recent development in the high moment method for the local and intersection local times related to Brownian method and random walks

NONLINEAR EXPECTATIONS AND NONLINEAR PRICING

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Kun He *Shandong University, China*
Reg Kulperger *The University of Western Ontario, Canada*

Key words: risk measure, coherent risk, convex risk, Choquet expectation, g-expectation, backward stochastic differential equation, converse comparison theorem, BSDE, Jensen's inequality.

Mathematical Subject Classification: 60H10.

Abstract: As the generalizations of mathematical expectations, coherent and convex risk measures, Choquet expectation and Peng's g-expectations all have been widely used to study the question of hedging contingent claims in incomplete markets. Obviously, the different risk measures or expectations will typically yield different pricing. In this paper we investigate differences amongst these risk measures and expectations in the framework of the continuous-time asset pricing. We show that the coherent pricing is always less than the corresponding Choquet pricing. This property and inequality fails in general when one uses pricing by convex risk measures. Finally, we show that g-expectations are the better way for the pricing options for the claims with higher interest rate for borrowing and with short-sales constraints.

DISCRETE APPROXIMATIONS TO REFLECTED BROWNIAN MOTION

Zhenqing CHEN *University of Washington, USA.* E-mail: zchen@math.washington.edu

Abstract: In this talk, I will present three discrete or semi-discrete approximation schemes for reflected Brownian motion on bounded Euclidean domains. For a class of bounded domains D in R^n that includes all bounded Lipschitz domains and the von Koch snowflake domain, we show that the laws of both discrete and continuous time simple random walks on $D \cap 2^{-k}Z^n$ with stationary initial distribution converge weakly in the space of $D([0,\infty), \overline{D})$, equipped with the Skorokhod topology, to the law of the stationary reflected Brownian motion on D. We further show that the following "myopic conditioning" algorithm generates, in the limit, a reflected Brownian motion on any bounded domain D. For every integer $k \geq 1$, let $\{X^k_{j2^{-k}}, j = 0, 1, 2, \dots\}$ be a discrete time Markov chain with one-step transition probabilities being

the same as those for the Brownian motion in D conditioned not to exit D before time 2^{-k}. We prove that the laws of X^k converge to that of the reflected Brownian motion on D.

This talk is based on joint work with Krzysztof Burdzy.

MONGE OPTIMAL TRANSPORT MAPS AND FOKKER-PLANCK EQUATIONS

Shizan FANG *University of Bourgogne, France.* E-mail: fang@u-bourgogne.fr

Abstract: We shall show the role of Monge optimal transport maps in the construction of solutions to Fokker-Planck Equations.

LIMITING THEOREMS ASSOCIATED WITH TWO-PARAMETER POISSON-DIRICHLET DISTRIBUTION

Shui FENG *McMaster University, Canada.* E-mail: shuifeng@univmail.cis.mcmaster.ca

Abstract: Two-paremeter Poisson-Dirichlet Distribution arises naturally in Baysian statistics, macroeconomics, ecology, genetics, and physics. Comparing to the one-parameter (population size parameter) Poisson-Dirichlet distribution, the role of the additional parameter is to redistribute the masses evenly. Limitng theorems such as large deviations will be presented for the two-parameter Poisson-Dirichlet distribution and two-parameter Dirichlet process. The motivation for these results is to understand the differences between the two-parameter models and their one-parameter counterparts when the population size is lrage. New insight is obtained about the role of the additional parameter through a comparison with the corresponding results for the one-parameter Poisson-Dirichlet distribution and Dirichlet process.

RECENT PROGRESS ON BOUNDARY THEORY OF MARKOV PROCESSES

Masatoshi FUKUSHIMA *Osaka University, Japan.* E-mail: fuku@cg-s.bias.ne.jp

Abstract: Given a Markov process X on a state space E and a subset F of E, we may associate the minimal process X^0 on $E_0 = E \setminus F$ and the time changed process Y on F: X^0 and Y are obtained from X by killing upon leaving E_0, and with the time substitution by the inverse of the local time on F, respecively. There are yet another associated process that has attracted the interest of researchers for many years: the excursions of X away from the set F. The boundary theory of Markov processes addresses interrelationship among those objects and concerns how X is determined by X^0 and quantities intrinsic to X^0, and furthermore, based on this information, how extensions of X^0 to E or to some other extended spaces of E_0 can be constructed. I shall talk about some recent progress [6] $\sim$ [15] on this subject with an overview of the historical developments leading to those papers. A key word is *Feller measures* going back to [1] where W. Feller proposed a boundary problem for Markov chains.

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MODERATE DEVIATIONS FOR POISSON-DIRICHLET DISTRIBUTION

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KEY WORDS: Poisson process, Poisson-Dirichlet distribution, Dirichlet processes, GEM representation, Homozygosity, large deviations, Moderate deviations.

MATHEMATICAL SUBJECT CLASSIFICATION: Primary 60F10; secondary 92D10.

Abstract: Poisson-Dirichlet distribution arises in many different areas. The parameter θ in the distribution is the scaled mutation rate of a population in the context of population genetics. The limiting procedure of θ approaching infinity is practically motivated and has led to new interesting mathematical structures. Results of law of large numbers, fluctuation theorems and large deviations have been successfully established. In this paper moderate deviation principles are established for Poisson-Dirichlet distribution, GEM distribution, the homozygosity, and Dirichlet process when parameter θ approaches infinity. These results combined with earlier work provide a complete picture of the asymptotic behavior of Poisson-Dirichlet distribution for large θ. The moderate deviation results also reveal some new structures that are not observed in results of large deviations.

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THE LÉVY-FOKKER-PLANCK EQUATION: PHI-ENTROPIES AND CONVERGENCE TO EQUILIBRIUM

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KEY WORDS: Fokker-Planck equation, Lévy operator, Φ-entropy inequalities, entropy production method, logarithmic Sobolev inequalities, fractional Laplacian

MATHEMATICAL SUBJECT CLASSIFICATION: 46N20, 47G20, 35K15

Abstract: The paper is written in collaboration with C. Imbert from Paris-Dauphine University (France).

We study a Fokker-Planck equation of the form

$$u_t = \mathcal{I}[u] + \mathrm{div}(xu)$$

where the operator $\mathcal{I}$, which is usually the Laplacian, is replaced here with a general Lévy operator. We prove by the entropy production method the exponential decay in time of the solution to the only steady state of the associated stationnary equation.

Results of the article generalize the paper of BILER and KARCH in [1]. The main tools is logarithmic Sobolev inequality for Lévy process proved by WU in [3] and generalized by CHAFAI in [2].

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Essential spectral radius for positive operators on L^1 and L^∞ spaces

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Liming Wu *Université Blaise Pascal, France*

KEY WORDS: Essential spectral radius, Positive operators, L^1 and L^∞-spaces

MATHEMATICAL SUBJECT CLASSIFICATION: 60J05, 60F10, 47A10, 47D07.

Abstract: For a positive operator π on L^1 and L^∞ spaces over Polish probability spaces, we have proved that

Theorem 1. *For an nonnegative operator $\pi : L^p \to L^p$ with $p = 1, \infty$ (if $p = \infty$, π is also a kernel operator) we have*

$$r_{ess}(\pi|_{L^1}) = r_{tail(L^1)}(\pi),\ r_{ess}(\pi|_{L^\infty}) = r_{tail(L^\infty)}(\pi). \tag{1}$$

Proposition 2. *Let π be a symmetric positive operator on L^2 with a bounded kernel. Then for any $1 < p < \infty$*

$$r_{ess}(\pi|_{L^p}) \le r_{tail(L^1)}(\pi|_{L^1}) = r_{tail(L^\infty)}(\pi|_{L^\infty}). \tag{2}$$

Proposition 3. *Suppose that $Supp(\mu) = E$. Then for a positive Feller kernel operator π on L^∞ we have*

$$r_{tail(L^\infty)}(\pi) = r_{ess}(\pi|_{C_b(E)}). \tag{3}$$

Corollary 4. *Suppose that $Supp(\mu) = E$, and the positive Feller operator π satisfying that*

- *$r_{tail(L^\infty)}(\pi) < r_{sp}(\pi)$ (i.e., TNC),*
- *π is topologically transitive,*

where the topologically transitivity of π means that for any $x \in E$ and any nonempty open subset $O \subset E$ there is an integer $N \geq 1$ satisfying that $\pi^N(x, O) > 0$ for the Feller kernel $\pi(x, dy)$ of π. Then π is ergodic in $C_b(E)$ and L^∞.

Proposition 5. *For any nonnegative bounded kernel π on $(E, \mathcal{B})$ we have*

$$\sup_{\mu:\ \mu\pi \ll \mu} r_{ess}(\pi|_{L^\infty}) = \sup_{\mu:\ \mu\pi \ll \mu} r_{tail(L^\infty(\mu))}(\pi) \leq r_\tau(\pi|_{b\mathcal{B}}) \leq r_\Delta(\pi|_{b\mathcal{B}}) = r_{ess}(\pi|_{b\mathcal{B}}). \tag{4}$$

Corollary 6. *For any nonnegative bounded Feller kernel π*

$$\begin{aligned} r_{ess}(\pi|_{C_b(E)}) &= \sup_{\mu:\ \mu\pi \ll \mu,\ Supp(\mu)=E} r_{ess}(\pi|_{L^\infty(\mu)}) = \sup_{\mu:\ \mu\pi \ll \mu} r_{tail(L^\infty(\mu))}(\pi) \\ &= r_\tau(\pi|_{b\mathcal{B}}) = r_\Delta(\pi|_{b\mathcal{B}}) = r_{ess}(\pi|_{b\mathcal{B}}). \end{aligned} \tag{5}$$

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RANDOM CONTINUED FRACTIONS

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Abstract: Given a terminating or non-terminating sequence of positive integers, the continued fraction determined by this sequence gives a positive real number. Moreover, every positive real can be represented this way. Research on properties of this continued fraction representation had been a significant part in classical mathematics. The most important of these has been the study of the Gauss dynamical system. A stochastic counterpart of this is when the continued fractions are generated by sequences of random variables, giving rise to Random Continued Fractions. For the case of a sequence of i.i.d. non-negative random variables, the random continued fraction converges almost surely. A related markov chain and its ergodic properties play a crtical role in deriving interesting properties of this limit random variable. Some special cases give rise to interesting distributions for the limit random variable. These ideas extend in natural way to higher dimensions.

SLE AND α-SLE DRIVEN BY LÉVY PROCESSES

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Abstract: Schramm Loewner Evolutions (SLE) are random planar curves (if $\kappa \leq 4$) or growing compact sets generated by a curve (if $\kappa > 4$). We consider more general Lévy processes as the driving processes which give increasing clusters with trees-like structure. We show that when the driving force is of the form $\sqrt{\kappa}B + \theta^{1/\alpha}S$ for a Brownian motion B and a symmetric α-stable process S, the cluster has zero or positive Lebesgue measure according to whether $\kappa \leq 4$ or $\kappa > 4$. Due to the different scale invariant properties between Brownian motion and symmetric α-stable processes, we introduce a new class of evolutions called α-SLE. The corresponding clusters have α-self-similarity. We show the phase transition at a critical coefficient $\theta = \theta_0(\alpha)$ analogous to the $\kappa = 4$ phase transition in Brownian SLE. This talk is based on a joint work with Matthias Winkel.

ON COAGULATION-FRAGMENTATION PROCESSES

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Key words: Existence and uniqueness, stationary distribution, critical behavior.

Mathematical Subject Classification: 60K35.

Abstract: The coagulation-fragmentation process describes the random aggregation and breakup of clusters of particles which can model aerosols, blood coagulation, chemical polymerization and so on. Various aspects of the processes have been extensively studied by many authors ([1]-[8]). In this talk we present mainly our works on the processes in recent years, which include the existence and uniqueness of the processes in infinite dimension, stationary distributions (invariant measure), phase transition (gelation) and critical value or line ([9]-[15]).

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DISCONTINUOUS SUPERPROCESSES WITH DEPENDENT SPATIAL MOTION

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Abstract: We construct a class of discontinuous superprocesses with dependent spatial motion and general branching mechanism. The process arises as the weak limit of critical interacting-branching particle systems where the spatial motions of the particles are not independent. This work generalizes the model introduced in [D.A. Dawson, Z. Li, H. Wang, Superprocesses with dependent spatial motion and general branching densities, Electron. J. Probab. 6(2001), no.25, 33 pp. (electronic)] where quadratic branching mechanism was considered.

STOCHASTIC SYSTEM: A STUDY OF THREE EXAMPLES

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KEY WORDS: Accelerating diffusions, spectral gap, torus, antisymmetric perturbation, Nyström method, random matrix, stock dynamics, hierarchical segmentation, empirical invariance, volatile duration distribution, trading strategy.

MATHEMATICAL SUBJECT CLASSIFICATION: 60J60, 47D07, 65B99, 35P05, 15A52, 91B28, 60F15.

Abstract: The study of stochastic systems is usually very difficult even for the calculation of examples. Computer simulations help us to form conjectures. Rigorous proofs come later in [1] for the accelerating convergence on torus and [2] for the Nystrom approximation of the largest eigenvalues and the corresponding eigenvectors for large positive definite random matrices. In [3] empirical study strongly suggests the existence of a new invariance in financial market, but the mathematical formulation is still elusive.

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INTRINSIC ULTRACONTRACTIVITY FOR NON-SYMMETRIC LÉVY PROCESSES

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KEY WORDS: stable processes, non-symmetric stable process, Lévy process, non-symmetric Lévy process, semigroups, non-symmetric semigroups, parabolic boundary Harnack principle, intrinsic ultracontractivity

MATHEMATICAL SUBJECT CLASSIFICATION: Primary: 47D07, 60J25; Secondary: 60J45.

Abstract: Recently in [1], we extended the concept of intrinsic ultracontractivity to non-symmetric semigroups and proved that for a large class of non-symmetric diffusions Z with measure-valued drift and potential, the semigroup of Z^D (the process obtained by killing Z upon exiting D) in a bounded domain is intrinsic ultracontractive under very mild assumptions.

In this talk, we discuss the intrinsic ultracontractivity for non-symmetric discontinuous Lévy processes. We prove that, for a large class of non-symmetric discontinuous Lévy processes X in any bounded open set D is intrinsic ultracontractive. In particular, for the non-symmetric stable process X, the semigroup of X^D is intrinsic ultracontractive for any bounded set D.

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TRANSPORT-INFORMATION INEQUALITIES FOR MARKOV PROCESSES

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KEY WORDS: Transport inequalities, Fisher information, Poincaré inequality, logarithmic Sobolev inequalities, Markov processes

Abstract: One investigates the following type of transport-information T_cI inequalities:

$$\alpha(T_c(\nu,\mu)) \leq I(\nu|\mu)$$

for all probability measures ν on some metric space $(\mathcal{X},d)$, where μ is a given probability measure, $T_c(\nu,\mu)$ is the transport cost from ν to μ with respect to some cost function $c(x,y)$ on $\mathcal{X}^2$, $I(\nu|\mu)$ is the Fisher-Donsker-Varadhan information of ν with respect to μ and $\alpha:[0,\infty)\to[0,\infty]$ is some increasing function.
Using large deviation techniques, it is shown that T_cI is equivalent to some non-asymptotic *concentration inequality* for the occupation measure of an $\mathcal{X}$-valued μ-reversible ergodic Markov process related to $I(\cdot|\mu)$.
Tensorization properties are derived as well as comparisons with Poincaré and log-Sobolev inequalities. Explicit criteria are obtained for diffusion processes.

This talk is based on joint work with Arnaud Guillin, Liming Wu and Nian Yao.

RIESZ TRANSFORMS, POINCARÉ INEQUALITIES AND HODGE THEORY ON COMPLETE RIEMANNIAN MANIFOLDS

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Abstract: During the decade 1930-1940, Sir W. Hodge established the Hodge theory on compact Riemannian manifolds. Since then, many people have tried to extend the Hodge theory to complete non-compact Riemannian manifolds. In my talk, I will first review some known results on the L^2-Hodge theory on complete Riemannian manifolds. Then I will describe my recent work on the L^p-Hodge theory on complete Riemannian maniolds for $p\neq 2$, in which the Riesz transforms and the Poincaré inequalities play an important role.

THEORY OF ANTICIPATING LOCAL TIME

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Abstract: In this talk the speaker will introduce main results on theory of non-adapted anticipating local times recently introduced and proved by Malliavin, Nualart, Tudor, Liang, Zhang, Cao and He, and others. Moreover, the speaker will also presents some open questions on the topic.

A BRANCHING RANDOM WALK ON R IN RANDOM ENVIRONMENT

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Abstract: We consider a branching random walk on $\mathbf{R}$ in a stationary and ergodic random environment $\xi = (\xi_n)$ indexed by time $n \in \mathbf{N}$. Assume that each ξ_n corresponds to a point distribution $\pi_n = \pi(\xi_n)$ on $\mathbf{R}$. The process begins with one initial particle $\emptyset$ of generation 0 located at $S_\emptyset = 0 \in \mathbf{R}$. Each particle $u = u_1...u_n$ of generation n is replaced by N_u new particles of generation $n+1$, with displacements $L_{u1}, L_{u2,...}, L_{uN_u}$, so that the $i-th$ child is located at $S_{u_i} = S_u + L_{ui}$, where the point process $(N_u; L_{u1}, ..., L_{uN_u})$ is of distribution π_n conditional on $\xi = (\xi_n)$. The random variables $(N_u; L_{u1}, ..., L_{uN_u})$, indexed by finite sequences u, are supposed to be conditionally independent of each other given the environment ξ. For $A \subset \mathbf{R}$, let $Z_n(A)$ be the number of particles of generation n situated in A, and let $\tilde{Z}_n(t) = \sum_{|u|=n} e^{tS_u}$ be the partition function. We consider the case where the corresponding branching process $\{Z_n(\mathbf{R})\}(\mathbf{n} \in \mathbf{N})$ is supercritical, and show limit theorems about Z_n and $\tilde{Z}_n$: we show that the free energy (or pressure) $\frac{\log \tilde{Z}_n(t)}{n}$ converges almost surely to a limite that we calculate explicitly, establish a large deviation principle for the sequence of counting measures $\{Z_n\}$, and prove that the position R_n (resp. L_n) of the rightmost (resp. leftmost) particle of generation n satisfies a law of large numbers: R_n/n (resp. L_n/n) converges a.s. to a limit that we calculate explicitly.

REGULARITY OF SOLUTIONS TO DIFFERENTIAL EQUATIONS WITH NON-LIPSCHITZ COEFFICIENTS

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Abstract: We study the ordinary and stochastic differential equations whose coefficients satisfy certain non-Lipschitz conditions, namely, we study the behaviors of small subsets under the flows generated by these equations. If the divergence of the driven vector field is bounded, then the Lebesgue measure is quasi-invariant under the flow.

CATALYTIC DISCRETE STATE BRANCHING MODELS AND RELATED LIMIT THEOREMS

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Abstract: Catalytic discrete state branching processes with immigration are defined as strong solutions of stochastic integral equations. We provide main limit theorems of those processes using different scalings. The class of limit processes of the theorems includes essentially all continuous state catalytic branching processes and spectrally positive regular affine processes, respectively.

SPECTRAL GAP AND CONVEX CONCENTRATION INEQUALITIES FOR BIRTH-DEATH PROCESSES

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Abstract: Consider a birth-death process with generator $\mathcal{L}$ and reversible invariant probability π. Given an increasing function ρ and the associated Lipschitz norm $\|\cdot\|_{\mathrm{Lip}(\rho)}$, we find an explicit formula for $||(-\mathcal{L})^{-1}||_{\mathrm{Lip}(\rho)}$. As a typical application, with spectral theory, we revisit one variational formula of M.F. Chen for the spectral gap of $\mathcal{L}$ in $L^2(\pi)$. Moreover, by Lyons-Zheng's forward-backward martingale decomposition theorem, we get convex concentration inequalities for additive functionals of birth-death processes.

SPECTRAL GAP FOR QUASI-BIRTH-DEATH PROCESSES WITH APPLICATION TO JACKSON NETWORKS

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Abstract: In this joint paper with Mu-Fa Chen and Liang-Hui Xia, we use the decomposition skill to give the estimate of spectral gap for reversible quasi-birth-death processes, with an application to the open Jackson networks.

UNIQUENESS FOR VOLTERRA-TYPE STOCHASTIC EQUATION

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Abstract: Let σ be a Hölder continuous function with index $\gamma \leq 1$ and set $\alpha \in (0, 1/2)$. Consider the following Volterra-type stochastic equation driven by Brownian motion B

$$X_t = X_0 + \int_0^t (t-s)^{-\alpha}\sigma(X_s)\mathrm{d}B_s.$$

This equation can also be interpreted as a degenerate SPDE. We are interested in the set of parameters α, γ for which the pathwise uniqueness holds for the above equation. This is a joint work with Tom Salisbury.

SOME STABILITY RESULTS OF OPTIMAL INVESTMENT IN A SIMPLE LÉVY

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Abstract: We investigate some investment problems of maximizing the expected utility of the terminal wealth in a simple Lévy market, where the stock price is driven by a Brownian motion plus a Poisson

process. The optimal investment portfolios are given explicitly under the hypotheses that the utility functions belong to the HARA, exponential and logarithmic classes. We show that the solutions for the HARA utility are stable in the sense of weak convergence when the parameters vary in a suitable way.

FUNCTIONAL CENTRAL LIMIT THEOREM FOR SPATIAL BIRTH AND DEATH PROCESSES

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KEY WORDS: spatial birth and death processes, Poisson random measures, stochastic equations, functional central limit theorem. hub

Abstract: For any bounded and integrable function in Euclidean space (with respect to Lebesgue measure), we define a family of processes which is obtained by integrals of the function with respect to the centered and scaled spatial birth and death process with constant death rate. We give conditions on the birth rate such that this family converges weakly to some Gaussian process. By Mitoma (1983), under an appropriate topology, the centered and scaled spatial birth and death process will converge weakly to a distribution-valued process. We also give the same result for spatial pure birth processes with constant death rate and apply our theorem to random packing problem obtaining the results of Penrose and Yukich (2002). In order to show the convergence of the finite-dimensional distributions of the above processes, we extend the multivariate spatial central limit theorem in Penrose (2005) to a more general case. Then we apply the extended theorem to the stochastic equations for spatial birth and death processes in Garcia and Kurtz (2006).

MODIFIED LOGARITHMIC SOBOLEV INEQUALITIES AND TRANSPORTATION COST INEQUALITIES IN EUCLIDEAN SPACE

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KEY WORDS: Modified logarithmic Sobolev inequalities, Hamilton-Jacobi semigroup, Prékopa-Leindler inequalities, Transportation cost inequalities

Abstract: In this talk, the modified logarithmic Sobolev inequalities and transportation cost inequalities for measures with density e^{-V} in $\mathbb{R}^n$ are established. It is proved by using Prékopa-Leindler inequalities following the idea of Bobkov-Ledoux, but a different type of condition is used which recovers Bakry-Emery criterion. As an application, we establish the modified log-Sobolev and transportation cost inequalities for the Gaussian type measures $e^{-|x|^p}\mathrm{d}x$ for $p > 1$ in $\mathbb{R}^n$. We also give out explicit estimates for their constants.

ON THE CONVERGENCE RATES TO THE EQUILIBRIUM FOR THE BROWNIAN MOTION WITH DIVERGENCE FREE DRIFTS

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Abstract: We consider the diffusion process on d-dim torus $\mathbf{T}$,

$$dX^{(c)}(t) = cb(X^{(c)}(t))dt + dB(t),$$

where $B(t)$ is the Brownian motion. We assume $b(\cdot)$ is a smooth vector field with period 1 and $b(\cdot)$ is divergence free, which means $div(b) = 0$. The last condition implies that the Lebegues measure on $\mathbf{T}$ is the invariant measure for $X^{(c)}(t)$. We study the rates of convergence of $X^{(c)}(t)$ to the equilibrium for large c. Our main result is the following.

Let $L^{(c)}$ be the generator of $X^{(c)}(t)$,

$$L^{(c)}f = \frac{1}{2}\Delta f + cb \cdot \nabla f.$$

Define

$$\rho^{(c)} = \inf\{-Re(\rho); \rho \neq 0, \rho \text{ is in the spectrum of } L^{(c)}\}.$$

$\rho^{(c)}$ is used to measure the convergence rate of the diffusion process $X^{(c)}(t)$ to the equilibrium. That is, for some $K(c)$,

$$\int_{\mathbf{T}} |p_t^{(c)}(x,y) - 1|dy \leq K(c)\exp(-\rho^{(c)}t),$$

$p_t^{(c)}(x,y)$ is the transition density of $X^{(c)}(t)$. We show that $\rho^{(c)}$ converges to $\rho^{(\infty)}$ as $c \to \infty$. Here

$$\rho^{(\infty)} = \inf\{\frac{1}{2}\int_{\mathbf{T}} |\nabla\phi(x)|^2 dx\},$$

where the infimum is taken over all $\phi = \phi_1 + i\phi_2$ such that

$$\int_{\mathbf{T}} \phi(x)dx = 0, \ \int_{\mathbf{T}} |\phi(x)|^2 dx = 1$$

and $b\nabla\phi = i\mu\phi$ for some $\mu \in R$. Some examples to calculate $\rho^{(\infty)}$ will be given.

BOUNDARY HARNACK PRINCIPLE FOR SUBORDINATE BROWNIAN MOTIONS

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Abstract: In this talk I will present some recent results on the potential theory of subordinate Brownian motions. We will show that, for a large class of subordinate Brownian motions, the boundary Harnack inequality is valid. The results presented here are generalizations of earlier results for symmetric stable processes by Bogdan (97) and Song-Wu (99), and earlier results for relativistic stable processes by Ryznar (02) and Chen-Song (03). The results of this talk are based on joint work with Panki Kim and Zoran Vondracek.

PERFORMANCE ANALYSIS OF JOINING THE SHORTEST QUEUE MODEL AMONG A LARGE NUMBER OF QUEUES

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Yiqiang Q. Zhao *Carleton University, Canada*

KEY WORDS: Queue, join the shortest queue, performance analysis, birth death process, mean-field, nonlinear master equation, law of large numbers.

MATHEMATICAL SUBJECT CLASSIFICATION: 60K25; 60F05; 60J27; 60K35

Abstract: Consider a queueing network with N nodes in which each queue has a dedicated input stream and N is large. There is an extra input stream, which balances the load of the network by directing its arriving customers to the shortest queue. A mean field interaction model is set up to study the performance of this network in terms of limiting results. One of our results shows that the stationary behavior of any of the queues is approximated by that of the $M/M/1$ queue with a modified boundary transition rate.

COUPLING METHOD FOR HARNACK INEQUALITIES AND APPLICATIONS

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Abstract: We first briefly recall some known results on Harnack inequality and applications, then introduce a coupling method to derive dimension-free Harnack inequalities. Specific examples in both finite and infinite dimensions are provided.

A CLASS OF INTERACTING SUPERPROCESSES AND THEIR ASSOCIATED SPDES

Hao WANG *University of Oregon, USA.* E-mail: haowang@uoregon.edu

Abstract: In this talk, the construction, characterization, and properties of a class of interacting superprocesses will be discussed. In particular, we will talk about their associated stochastic partial differential equations and stochastic evolution equations.

UNIQUENESS OF THE CRITICAL PROBABILITY FOR PERCOLATION IN THE TWO DIMENSIONAL SIERPIŃSKI CARPET LATTICE

Xian-Yuan WU *Capital Normal University, China.* E-mail: wuxy@mail.cnu.edu.cn

Abstract: We prove that the critical probability for the Sierpiński carpet lattice in two dimensions is uniquely determined. The transition is sharp. This extends the Kumagai's result to the original Sierpiński carpet lattice.

This talk is based on joint work with Yasu Higuchi.

ON SWITCHING DIFFUSIONS AND JUMP-DIFFUSIONS

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KEY WORDS: Feller continuity, Radon-Nikodym derivative, coupling, strong Feller continuity, exponential ergodicity, state-dependent switching, Markovian switching, jump-diffusion.

MATHEMATICAL SUBJECT CLASSIFICATION: 60J60, 34D25.

Abstract: Let $(X(t), Z(t))$ be a right continuously strong Markov process with the phase space $R^d \times N$, where $N := \{1, 2, \cdots, n_0\}$. The first component $X(t)$ satisfies the following stochastic differential equation

$$dX(t) = b(X(t), Z(t))dt + \sigma(X(t), Z(t))dB(t).$$

The second component $Z(t)$ is a discrete random process with the finite state space N such that:

$$P\{Z(t+\Delta) = l | Z(t) = k, X(t) = x\} = \begin{cases} q_{kl}(x)\Delta + o(\Delta), & \text{if } k \neq l, \\ 1 + q_{kk}(x)\Delta + o(\Delta), & \text{if } k = l \end{cases}$$

uniformly in R^d, provided $\Delta \downarrow 0$, where $0 < q_{kl}(x) < +\infty$ for all $k \neq l \in N$. Generally, the strong Markov process $(X(t), Z(t))$ can be called a diffusion process with state-dependent switching. In particular, when the functions $q_{kl}(x)$ are independent of x (i.e., $q_{kl}(x) \equiv q_{kl} > 0$ for all $k \neq l$) and the second component $Z(t)$, which is independent of $B(t)$, is a Markov chain itself, the corresponding strong Markov process $(X(t), Z(t))$ then can be called a diffusion process with Markovian switching. A diffusion process with state-dependent switching or Markovian switching is often called a switching diffusion. The Markov process $(X(t), Z(t))$ is said to be stable in f-norm if there exists a probability measure $\pi(\cdot)$ such that its transition probability $P(t, (x, k), \cdot)$ converges to $\pi(\cdot)$ in f-norm as $t \to 0$ for every $(x, k) \in R^d \times N$. The so-called f-norm is a very strong norm and the well known total variation norm is only a special case of it. Our main aim in the present work is to investigate the stability in f-norm for diffusion processes with state-dependent switching. Actually, we will prove the f-exponential ergodicity for these processes under some reasonable conditions. In the course of pursuing the above objective, we will also prove the Feller continuity for these processes by making use of the Radon-Nikodym derivatives and more the strong Feller continuity for them under some reasonable conditions. Finally, we also give a very brief discussion about the Feller continuity, strong Feller continuity and f-exponential ergodicity for a class of jump-diffusions with Markovian switching.

SAMPLE PATH PROPERTIES OF LÉVY PROCESSES

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KEY WORDS: Lévy processes, regenerative sets, range, intersections and multiple points, Hausdorff dimension.

Mathematical Subject Classification: 60G60, 60J55, 60J45.

Abstract:

The sample functions of Lévy processes have rich analytic and geometric properties. Many of them have been studied since 1960's [see the survey papers of Fristedt (1974), Taylor (1986) and Xiao (2004)]. This talk is concerned with the intersection problems for Lévy processes and regenerative sets. We apply potential theory of multiparameter Lévy processes to establish necessary and sufficient conditions for the existence of intersections, and to determine the Hausdorff dimension of the intersection set when it is non-empty. Our results improve those of Fitzsimmons and Salisbury (1989) and solve a conjecture of Bertoin (1999a).

This talk is based on joint articles with Davar Khoshnevisan.

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A CENTRAL LIMIT TYPE THEOREM FOR A CLASS OF PARTICLE FILTERS

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Abstract: The optimal filter $\pi = \{\pi_t, t \geq 0\}$ for a general observation model is approximated by a probability measure valued process $\pi^n = \{\pi_t^n, t \geq 0\}$. The process π^n is the empirical measure of a system of weighted particles that at time 0 consists of n particles. The particles branch at equally spaced time instances $jn^{-2\alpha}$ where $j = 1, 2, ...$ and $0 < \alpha < 1$. We prove the convergence of the process π^n to π and derive sharp upper bounds for the mean square error. We also prove a central limit theorem to characterize the convergence rate of the approximate filter. A similar result is obtained for the unweighted, unnormalized version introduced in Crisan-Gains-Lyons (1998). As a corollary, we show that $\alpha = \frac{1}{3}$ is the optimal exponent for that version. This talk is based on a joint paper with Crisan.

AN INTRODUCTION TO STOCHASTIC LOEWNER EVOLUTION (SLE)

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Abstract: We will give the definition of SLE, and its relation with some lattice models such as percolation, loop-erased random walk, uniform spanning tree, self-avoiding walk and others.

BOUNDARY VALUE PROBLEMS FOR ELLIPTIC OPERATORS WITH MEASURABLE COEFFICIENTS

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Abstract: In this talk, recent results on Dirichlet boundary value problems for elliptic operators with singular coefficients will be presented. The approach is probabilistic, and Dirichlet forms play an essential role.

BARTA'S FORMULA FOR THE PRINCIPLE EIGENVALUES OF SCHRÖDINGER OPERATORS

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KEY WORDS: Dirichlet form; variational formula; Schrödinger operator; estimation of the eigenvalue.

Abstract: In the report, we generalize the variational formula for Dirichlet form due to Shiozawa Y. and Takeda M., and get an estimation for the first eigenvalue of general Markov processes with cadlag path, i.e. Barta's formula, by use of the variational formula. The main idea is to use unbounded test functions in variational formula instead of the bounded ones, which produces more accurate estimation. Furthermore, the eigenvalue functions of Markov processes are not necessarily bounded, so the generalized Barta's formula should be more reasonable. As an application of Barta's formula above, we obtain Barta's formula for Schrödinger operators.

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