The 10th Workshop on Markov Processes and Related Topics

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Qujiang Hotel

Xidian University

Organizers: Mu-Fa Chen(BNU), San-Yang Liu(XIDIAN)

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Probability Group, Stochastic Research Center, Beijing Normal University

School of Mathematics and Statistics, Xidian University

Secretary: Wenchuang Zhou (Beijing Normal University)

Tele and Fax: 86-10-58809447 E-mail: rcstoch@bnu.edu.cn

Hui Ma (Xidian University)

Tele: 86-29-88202860 E-mail: hma@xidian.edu.cn

Website: http://math.bnu.edu.cn/probab/Workshop2014

	14/8	15/8	16/8	17/8	18/8
Chairman	**Feng-Yu Wang**	**Dayue Chen**	**George Yin**	**Elton P. Hsu**	**Chii-Ruey Hwang**
08:30-09:00	Opening & Take picture	Renming Song	Bo Wu(8:30-8:50) Jianhai Bao(8:50-9:10)	George Yin	Elton P. Hsu
09:00-09:30	Chii-Ruey Hwang	Yun-Shyong Chow	Jinghai Shao(9:10-9:30)	Jie Xiong	Zhen-Qing Chen
09:30-10:00	Qi-Man Shao	Dayue Chen	Dejun Luo(9:30-9:50)	Qingshuo Song	Hanjun Zhang
10:00-10:30	Tea break	Tea break	Tea break(9:50-10:30)	Tea break	Tea break
10:30-11:00	Fu-Zhou Gong	Tzuu-Shuh Chiang	Jian Wang(10:30-10:50) Chunmao Huang(10:50-11:10)	Xianping Guo	Yaozhong Hu
11:00-11:30	Chenggui Yuan	Xianyuan Wu	Wei Li(11:10-11:30)	Litan Yan	Yong Liu
Chairman	**Yuh-Jia Lee**	**Renming Song**		**Yingchao Xie**	**Zenghu Li**
14:30-15:00	Chunhua Ma(14:30-14:50) Hui He(14:50-15:10)	Yuh-Jia Lee		Quansheng Liu	Fuqing Gao
15:00-15:30	Congzao Dong(15:10-15:30)	Dong Han		Xiangdong Li	Jinwen Chen
15:30-16:00	Hua-Ming Wang(15:30-15:50)	Xicheng Zhang		Yong Ren	Yuanyuan Liu
16:00-16:30	Tea break(15:50-16:30)	Tea break		Tea break	Tea break
16:30-17:00	Xu Yang(16:30-16:50) Lijun Bo(16:50-17:10)	Yanxia Ren		Yongjin Wang	Shui Feng
17:00-17:30	Benchong Li(17:10-17:30)	Xiaowen Zhou		Guangjun Shen	Jiang-Lun Wu

August 14

	Chairman: Feng-Yu Wang
08:30-09:00	Opening and take pictures
09:00-09:30	Chii-Ruey Hwang (Academia Sinica, Taibei) *Variance reduction for diffusions*
09:30-10:00	Qi-Man Shao (Chinese University of Hong Kong, HK) *Identifying the limiting distribution*
10:00-10:30	Tea break
10:30-11:00	Fu-Zhou Gong (Chinese Academy of Sciences, Beijing) *Comparison theorems of spectral gaps of Schrödinger operators and diffusion operators on abstract Wiener spaces*
11:00-11:30	Chengui Yuan (Swansea University, UK) *Hypercontractivity, compactness, and exponential ergodicity for functional stochastic differential equations*
	Chairman: Yuh-Jia Lee
14:30-14:50	Chunhua Ma (Nankai University, Tianjin) *On the hitting times of continuous-state branching processes with immigration*
14:50-15:10	Hui He (Beijing Normal University, Beijing) *Limit theory of pruning processes for Galton-Watson trees*
15:10-15:30	Congzao Dong (Xidian University, Xi'an) *Superprocesses over a stochastic flow with spatially dependent branching*
15:30-15:50	Hua-Ming Wang (Anhui Normal University, Wuhu) *Birth and death process with bounded jumps in random environment*
15:50-16:30	Tea break
16:30-16:50	Xu Yang (Beifang University of Nationalities, Yinchuan) *The pathwise uniqueness of solution to a SPDE driven by α-stable noise*
16:50-17:10	Lijun Bo (Xidian University, Xi'an) *Optimal investment in defaultable securities under information driven default contagion*
17:10-17:30	Benchong Li (Xidian University, Xi'an) *Markov bases in algebraic statistics*

August 15

	Chairman: Dayue Chen
08:30-09:00	Renming Song (University of Illinois at Urbana-Champaign, USA) *Minimal thinness for Lévy processes*
09:00-09:30	Yun-Shyong Chow (Academia Sinica, Taibei) *Some recent results on evolutionary prisoner's dilemma games*
09:30-10:00	Dayue Chen (Peking University, Beijing) *Some questions concerning random walks on trees in a random environment*
10:00-10:30	Tea break
10:30-11:00	Tzuu-Shuh Chiang (Academia Sinica, Taibei) *Central limit theorem of diffusion processes with a small parameter in discontinuous media*
11:00-11:30	Xianyuan Wu (Capital Normal Unversity, Beijing) *A new lower bound for the threshold of the random 3-SAT model*
	Chairman: Renming Song
14:30-15:00	Yuh-Jia Lee (University of Kaohsiung, Kaohsiung) *Itô Formula for generalized white noise functionals, revisted*
15:00-15:30	Dong Han (Shanghai Jiao Tong University, Shanghai) *Degree distributions and the critical surface of epidemic spreading on a random growth network*
15:30-16:00	Xicheng Zhang (Wuhan University, Wuhan) *Stochastic differential equations with Sobolev coefficients and applications*
16:00-16:30	Tea break
16:30-17:00	Yanxia Ren (Peking University, Beijing) *Limit theorems for some critical superprocesses*
17:00-17:30	Xiaowen Zhou (Concordia University, CA) *Laplace transforms of occupation times for spectrally negative Lévy processes*

August 16

	Chairman: George Yin
08:30-08:50	Bo Wu (Fudan University, Shanghai)
	Quasi-regular Dirichlet forms on Riemannian loop spaces
08:50-09:10	Jianhai Bao (Central South University, Changsha)
	Numerical approximation of invariant measures for SDEs with regime switching
09:10-09:30	Jinghai Shao (Beijing Normal University, Beijing)
	Recurrent properties of regime-switching diffusions
09:30-09:50	Dejun Luo (Chinese Academy of Sciences, Beijing)
	Quasi-invariance of the stochastic flow associated to Itô's SDE with singular time-dependent drift
09:50-10:30	Tea break
10:30-10:50	Jian Wang (Fujian Normal University, Fuzhou)
	Exponential contractivity in the L^p-Wasserstein distance for stochastic differential equations with jumps
10:50-11:10	Chunmao Huang (Harbin institute of technology, Harbin)
	Law of large numbers for some Markov Chains along non homogenous genealogies
11:10-11:30	Wei Li (Xidian University, Xi'an)
	First passage of fractional-derivative stochatic systems with power-form restoring force

August 17

	Chairman: Elton P. Hsu
08:30-09:00	George Yin (Wayne State University, USA) *Some results on certain stochastic predator-prey models*
09:00-09:30	Jie Xiong (University of Macau, Macau & University of Tennessee, USA) *A linear-quadratic optimal control problem of forward-backward stochastic differential equations with partial information*
09:30-10:00	Qingshuo Song (City University of Hong Kong, HK) *Convergence on the approximation of path-dependent functionals*
10:00-10:30	Tea break
10:30-11:00	Xianping Guo (Sun Yat-Sen University, Guangzhou) *Continuous-time Markov decision processes with the finite horizon*
11:00-11:30	Litan Yan (Donghua University, Shanghai) *Derivative for the intersection local time of fractional Brownian motions*
	Chairman: Yingchao Xie
14:30-15:00	Quansheng Liu (Universite de Bretagne- Sud, France) *Asymptotic properties of supercritical branching processes in random environments*
15:00-15:30	Xiang-Dong Li (Chinese Academy of Sciences, Beijing) *On the generalized solution of the Navier-Stokes equations via optimal transportation*
15:30-16:00	Yong Ren (Anhui Normal University, Wuhu) *Mean-field backward stochastic differential equations with subdifferrential operator and its applications*
16:00-16:30	Tea break
16:30-17:00	Yongjin Wang (Nankai University, Tianjin) *On a class of skew diffusion processes*
17:00-17:30	Guangjun Shen (Anhui Normal University, Wuhu) *Weak convergence to the Rosenblatt sheet*

August 18

	Chairman: Chii-Ruey Hwang
08:30-09:00	Elton P. Hsu (Northwestern University, USA)
	Stochastic De Giorgi iteration and regularity of stochastic partial differential equations
09:00-09:30	Zhen-Qing Chen (University of Washington, USA)
	Scaling limits of interacting diffusions in domains
09:30-10:00	Hanjun Zhang (Xiangtan University, Xiangtan)
	Quasi-stationary distributions and their applications
10:00-10:30	Tea break
10:30-11:00	Yaozhong Hu (University of Kansas, USA)
	Density convergence for some nonlinear Gaussian stationary sequences
11:00-11:30	Yong Liu (Peking University, Beijing)
	On the eigenfunctions of the complex Ornstein-Uhlenbeck operators and applications
	Chairman: Zenghu Li
14:30-15:00	Fuqing Gao (Wuhan University, Wuhan)
	Laplace integrals for quadratic Wiener functionals and moderate deviations for parameter estimators
15:00-15:30	Jinwen Chen (Tsinghua University, Beijing)
	Quasi-stationarity and quasi-ergodicity of Markov processes
15:30-16:00	Yuanyuan Liu (Central South University, Changsha)
	Perturbation analysis for continuous-time Markov chains
16:00-16:30	Tea break
16:30-17:00	Shui Feng (McMaster University, Canada)
	Limit theorems for the frequency counts of the Ewens-Pitman model
17:00-17:30	Jiang-Lun Wu (Swansea University, UK)
	On the path-independence of Girsanov density for infinite-dimensional stochastic differential equations

NUMERICAL APPROXIMATION OF INVARIANT MEASURES FOR SDES WITH REGIME SWITCHING

Jianhai BAO *Central South University, PRC*, E-mail: jianhaibao13@gmail.com
Jinghai Shao *Beijing Normal University, China*
Chenggui Yuan *Swansea University, UK*

In this talk, by the Perron-Frobenius theorem and the principal eigenvalue method, we discuss the numerical approximation of invariant measure for a wide class of SDEs with regime switching, and several examples are constructed to demonstrate our theories.

OPTIMAL INVESTMENT IN DEFAULTABLE SECURITIES UNDER INFORMATION DRIVEN DEFAULT CONTAGION

Lijun BO *Xidian University, PRC*, E-mail: lijunbo@xidian.edu.cn
Agostino Capponi *Columbia University, USA*

Abstract: We introduce a novel portfolio optimization framework where a power investor decides on optimal portfolio allocations within an information driven default contagion model. The investor can allocate his wealth across several defaultable stocks whose growth rates and default intensities are driven by a hidden Markov chain. The latter acts as a frailty factor introducing dependency across defaults and affecting future comovements of security prices. By a suitable measure change, we reduce the partially observed stochastic control problem to an equivalent fully observed risk-sensitive control problem, where the state is given by the regime filtered probabilities. Using the dynamic programming principle, we then provide a rigorous analysis of default contagion manifested through dependence of the optimal strategies on the gradient of value functions in one-to-one correspondence with the default states of the economy. We prove a verification theorem showing that each value function is recovered as the generalized solution of the corresponding HJB PDE.

SOME QUESTIONS CONCERNING RANDOM WALKS ON TREES IN A RANDOM ENVIRONMENT

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

Abstract: Consider the speed $v(\lambda)$ of the λ-biased random walk on Galton-Watson trees. It was proved by Lyons, Pemantle & Peres that the speed $v(\lambda)$ exists. Recently E. Aidekon gave a nice formula for $v(\lambda)$ by computing the invariant measure for the walk. It was conjectured that $v(\lambda)$ is monotone on λ for $0 < \lambda < m$, where m is the mean of offspring. The conjecture is verified for λ very close to m, and very close to 0 respectively, by G. Ben Arous, Y. Hu, S. Olla and O. Zeitouni, G. Ben Arous, A. Fribergh and V. Sidoravicius. The monotonicity problem received many recent interests and has many alternatives. In the same spirit we consider the simple random walk on the infinite cluster of the Bernoulli bond percolation of trees, and investigate the relation between the speed of the simple random walk and the retaining probability p by studying three classes of trees. A sufficient condition is established for Galton-Watson trees. Some observations are made and some questions are raised.

QUASI-STATIONARITY AND QUASI-ERGODICITY OF MARKOV PROCESSES

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

Abstract: We will present some results concerning quasi-stationarity and quasi-ergodicity of a Markov process. Their connection with the decay parameter of the Markov process will also be discussed. Based on these results, a variational representation of this parameter will be given.

SCALING LIMITS OF INTERACTING DIFFUSIONS IN DOMAINS

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

Abstract: Interacting particle models can be used to gain understanding of the emergence of macroscopic phenomena from microscopic laws of nature. In this talk, I will introduce and discuss a class of interacting particle systems that can model the transport of positive and negative charges in solar cells. It can also be used to model the population dynamics of two segregated species under competition. To connect the microscopic mechanisms with the macroscopic behaviors at two different scales of observations, we prove the hydrodynamic limits and the fluctuation limits for the systems. In other words, we establish the law of large numbers and the central limit theorem, respectively, for the time-trajectory of the particle densities. The hydrodynamic limit is a pair of deterministic measures whose densities solve a coupled nonlinear heat equations, while the fluctuation limit can be described by a Gaussian Markov process that solves a stochastic partial differential equation.

This is joint work with Louis Fan.

CENTRAL LIMIT THEOREM OF DIFFUSION PROCESSES WITH A SMALL PARAMETER IN DISCONTINUOUS MEDIA

Tzuu-Shuh CHIANG *Institute of Mathematics, Academia Sinica,Taipei,Taiwan*,
E-mail:matsch@math.sinica.edu.tw
Shuenn-Jyi Sheu *Department of Mathematics, National Central University*

Abstract: For the system of $d-$dimesnional stochastic differential equation, $d \geq 2$,

$$dX_t^\epsilon = b(X_t^\epsilon)dt + \epsilon dW_t, \qquad t \in [0,T]$$

$$X_0^\epsilon = x \in H \subseteq R^d,$$

where $b(x) = (b_1(x), ..., b_d(x))$ is a bounded smooth vector field except along the hyperplane $H = \{x \in R^d, x_1 = 0\}$ but satisfies the stability condition in the sense that there exist positive constants δ and c such that $b_1(x) \leq -c$ if $x_1 \in (0,\delta)$ and $b_1(x) \geq c$ if $x_1 \in (-\delta, 0)$, we shall prove that the central limit theorem holds for $X^\epsilon(t)$. To be precise, we shall show that there exists a deterministic function $\phi(\cdot) \in C([0,T], R^d)$ such that the process $\frac{1}{\epsilon}(X^\epsilon(\cdot) - \phi(\cdot))$ converges to an Ornstein-Uhlenbeck proess in probability thus in distribution in $C([0,T], R^d)$ as $\epsilon \to 0$.

SOME RECENT RESULTS ON EVOLUTIONARY PRISONER'S DILEMMA GAMES

Yunshyong CHOW *Institute of Mathematics, Academia Sinica, Taipei, Taiwan*
E-mail: chow@math.sinica.edu.tw

KEY WORDS: evolutionary game, prisoner's dilemma game, long-run equilibrium

MATHEMATICAL SUBJECT CLASSIFICATION: 60J10, 91A22

Abstract: In the evolutionary PD games with local interaction, we propose some new strategy updating scheme that could get out of the dilemma in some cases.

References

[1] H.C. Chen & Y. Chow (2009). Evolutionary prisoner's dilemma games with one-dimensional local interaction and immitation, *Adv. App. Prob.*, **41**, 154-176.

[2] G. Ellsion (1993). Learning, local interaction and coordination, *Econometrica*, **61**, 1047-1071.

SUPERPROCESSES OVER A STOCHASTIC FLOW WITH SPATIALLY DEPENDENT BRANCHING

Congzao DONG *Xidian University, PRC*, E-mail: czdong@xidian.edu.cn

Abstract: We consider a typical superprocess over a stochastic flow, which arises from the attempt of modeling the behavior of phytoplankton blooms in oceanic tides. Such a model was originally studied by Skoulakis and Adler in 2001. In this talk, a generalization of their model is discussed, in which the branching of particles depends on their positions. We show the existence of superprocesses in a random medium (flow) with location dependent branching. Technically, we make use of a dual relationship to establish the uniqueness of the martingale problem and to obtain the moment formulas.

LIMIT THEOREMS FOR THE FREQUENCY COUNTS OF THE EWENS-PITMAN MODEL

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

Abstract: The Ewens-Pitman model describes the distribution of certain random partitions. The frequency count in the partition is a quantity that has attracted a lot of attention in recent years. In this talk we will present several limit theorems for the frequency counts.

LAPLACE INTEGRALS FOR QUADRATIC WIENER FUNCTIONALS AND MODERATE DEVIATIONS FOR PARAMETER ESTIMATORS

Fuqing GAO *Wuhan University*, E-mail: fqgao@whu.edu.cn
Hui JIANG *Nanjing University of Aeronautics and Astronautics*

Abstract: We study quadratic Wiener functionals and moderate deviations for parameter estimators in a linear stochastic differential equation model. Firstly, we give some estimates for Laplace integrals of the quadratic Wiener functionals by calculating the eigenvalues of the Hilbert-Schmidt operators associated with the quadratic functionals. Then applying the estimates, we establish deviation inequalities for the quadratic functionals and moderate deviation principles for the parameter estimators.

COMPARISON THEOREMS OF SPECTRAL GAPS OF SCHRÖDINGER OPERATORS AND DIFFUSION OPERATORS ON ABSTRACT WIENER SPACES

Fuzhou GONG *Institute of Applied Mathematics, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing 100190, China, Beijing*, E-mail: fzgong@amt.ac.cn
Yuan Liu and Dejun LUO *Institute of Applied Mathematics, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing 100190, China, Beijing*

Yong Liu *School of Mathematical Sciences, Peking University, Beijing 100871, China*
Key words: Spectral gap, Schrödinger operator, abstract Wiener space, min-max principle, Malliavin calculus.

Mathematical Subject Classification: primary 35P15, 35J10; secondary 60H10.

Abstract: How to use the information of coefficients in partial differential operators to get the information of spectrum of the operators? There exists a long literature of studying this problem from theory of diffusion processes and partial differential equations, and there are a lot of interesting problems need to answer. Among them there is a *fundamental gap conjecture* observed by Michiel van den Berg [J. Statist. Phys. 31(1983),no.3,623-637] and was independently suggested by Ashbaugh and Benguria [Proc. Amer. Math. Soc. 105(1989),no.2,419-424] and Yau [*Nonlinear analysis in geometry*, Monographies de L'Enseignement Mathématique,Vol.33,L'Enseignement Mathématique,Geneva, 1986. Série des Conférences de l'Union Mathématique Internationale,8], which gave an optimal lower bound of $\lambda_1 - \lambda_0$, the distance between the first two Dirichlet eigenvalues of a Schrödinger operator $-\Delta + V$ on a bounded uniformly convex domain Ω with a weakly convex potential V. By introducing the notion of *modulus of convexity* for functions, and studying the relationship between the modulus of convexity for V and the modulus of log-concavity for the first eigenfunciition (i.e. ground state) of Schrödinger operator $-\Delta + V$ through that of the one dimensional corresponding problems, Andrews and Clutterbuck [J. Amer. Math. Soc. 24 (2011), no. 3, 899–916] recently solved the fundamental gap conjecture. More interestingly, they proved a fundamental gap comparison theorem, that compare the fundamental gap of the Schrödinger operator $-\Delta+V$ with that of the one dimensional corresponding operator.

Note that, for the spectral gap of Schrödinger Operators and Diffusion Operators there are some sharp results for exponential integrability conditions of potential functions and diffusion coefficients such as Theorem 4.5 in [Simon and Hoegh-Krohn, JFA 1972] and Corollary 7.2 in [Fuzhou Gong and Liming Wu, J. Math. Pures Appl. 2006] in the literature. However, there was no nice estimates on the spectral gap or ground state. Roughly speaking, we have to make some control on the "derivative" of potential functions or diffusion coefficients, otherwise a high-frequency vibration on them will impact heavily on the spectral gap or ground state, but make no difference to the integrability.

In this talk we extend the fundamental gap comparison theorem of Andrews and Clutterbuck to the infinite dimensional setting. More precisely, we proved that the fundamental gap of the Schrödinger operator $-\mathcal{L}_* + V$ ($\mathcal{L}_*$ is the Ornstein–Uhlenbeck operator) on the abstract Wiener space is greater than that of the one dimensional operator $-\frac{d^2}{ds^2} + s\frac{d}{ds} + \tilde{V}(s)$, provided that $\tilde{V}$ is a modulus of convexity for V. Similar result is established for the diffusion operator $-\mathcal{L}_* + \nabla F \cdot \nabla$. The main results are as follows.

Let (W, H, μ) be an abstract Wiener space and $\mathcal{L}_*$ the Ornstein–Uhlenbeck operator on W associated to the symmetric Dirichlet form $\mathcal{E}_*(f, f) = (f, -\mathcal{L}_* f)$ with domain $\mathcal{D}[\mathcal{E}_*] = D_1^2(W, \mu)$ (i.e. $f \in L^2(W, \mu)$ with its Malliavin derivative $\nabla f \in L^2(W, H)$). Let $V \in D_1^p(W, \mu)$ for some $p > 1$ be a potential satisfying the *KLMN condition*, then one can define $-\mathcal{L} = -\mathcal{L}_* + V$ to be a self-adjoint Schrödinger operator bounded from below.

Correspondingly, let $\tilde{\mathcal{L}}_* = \frac{d^2}{ds^2} - s\frac{d}{ds}$ be the one-dimensional Ornstein–Uhlenbeck operator on R^1 with respect to the Gaussian measure $d\gamma_1 = (4\pi)^{-\frac{1}{2}} \exp(-\frac{s^2}{4})\, ds$. Let $\tilde{V} \in C^1(R^1) \cap L^1(R^1, \gamma_1)$ be a symmetric potential satisfying the KLMN condition too. Then $-\tilde{\mathcal{L}} = -\tilde{\mathcal{L}}_* + \tilde{V}$ is bounded from below. For convenience, a tilde will be added to all notations relative to $\tilde{\mathcal{L}}_*$ and $\tilde{V}$.

Let $< .,. >_H$ denote the inner product in the Cameron–Martin space H, and $|.|_H$ the norm.

Theorem A: Suppose for almost all $w \in W$ and every $h \in H$ with $h \neq 0$,

$$\left\langle \nabla V(w+h) - \nabla V(w), \frac{h}{|h|_H} \right\rangle_H \geq 2\tilde{V}' \left(\frac{|h|_H}{2} \right).$$

Then there exists a comparison

$$\lambda_1 - \lambda_0 \geq \tilde{\lambda}_1 - \tilde{\lambda}_0.$$

Hence, the existence of the spectral gap of $-\mathcal{L}$ on Wiener space can sometimes be reduced to one dimensional case. According to Andrews and Clutterbuck's notion, $\tilde{V}$ is a modulus of convexity for V. However, V doesn't need to be convex at all.

There are examples to show that, the above result is sharp, and the sharp exponential integrability of potential functions such as Theorem 4.5 in [Simon and Hoegh-Krohn, JFA 1972] can not be used but the above result can.

The next result gives the modulus of log-concavity for the ground state ϕ_0 of $-\mathcal{L}$.

Theorem B: Assume the same condition as in Theorem A and the gap $\tilde{\lambda}_1 - \tilde{\lambda}_0 > 0$. Then $-\mathcal{L}$ and $-\tilde{\mathcal{L}}$ have a unique ground state ϕ_0 and $\tilde{\phi}_0$ respectively. Moreover, for almost all $w \in W$ and every $h \in H$ with $h \neq 0$,

$$\left\langle \nabla \log \phi_0(w+h) - \nabla \log \phi_0(w), \frac{h}{|h|_H} \right\rangle_H \leq 2(\log \tilde{\phi}_0)' \left(\frac{|h|_H}{2} \right).$$

We also consider the diffusion operator $-\mathcal{L} = -\mathcal{L}_* + \nabla F \cdot \nabla$ on the Wiener space and we want to compare its spectral gap with the one dimensional operator $-\tilde{\mathcal{L}} = -\frac{d^2}{ds^2} + (s + \omega'(s))\frac{d}{ds}$. Although this kind of diffusion operator can be transformed to the Schrödinger type operator and their spectrum coincide with each other, the expression for the potential function V is a little complicated, hence it seems inappropriate to derive the gap comparison of diffusion operators from that of the transformed Schrödinger type operators. We shall directly establish the comparison theorem for spectral gaps of diffusion operators, and the main result is as follows.

Theorem C: Assume that $F \in D_1^p(W, R^1)$ satisfies $\int_W e^{-F}\, d\mu = 1$ and two functions F and ω are related by the following inequality: for all $h \in H$ and μ-a.e. $w \in W$,

$$\left\langle \nabla F(w+h) - \nabla F(w), \frac{h}{|h|_H} \right\rangle_H \geq 2\omega' \left(\frac{|h|_H}{2} \right).$$

Suppose also that $\omega \in C^1(R^1)$ is even, satisfying $\int_{R^1} e^{-\omega}\, d\gamma_1 = 1$ and $\lim_{t\to\infty} (\omega'(t) + t) = +\infty$. Then we have

$$\lambda_1 \geq \tilde{\lambda}_1.$$

There are also examples to show that, the sharp exponential integrability for diffusion coefficients ∇F such as Corollary 7.2 in [Fuzhou Gong and Liming Wu, J. Math. Pures Appl. 2006] and can not be used but the above result can.

The paper about the above all results has been published in [JFA,266(2014),5639-5675].

Furthermore, we give the probabilistic proofs of fundamental gap conjecture and spectral gap comparison theorem of Andrews and Clutterbuck in finite dimensional case via the coupling by reflection of the diffusion processes.

CONTINUOUS-TIME MARKOV DECISION PROCESSES WITH THE FINITE HORIZON

Xianping GUO, *Sun Yat-Sen University, PRC*, E-mail: mcsgxp@mail.sysu.edu.cn
Xiangxiang Huang, *Sun Yat-Sen University, PRC*
Yonghui Huang, *Sun Yat-Sen University, PRC*

Abstract: This talk focuses on the *finite horizon optimality* for continuous-time Markov decision processes within the class of all randomized *history-dependent* policies, for which some unsolved problems are raised by A.A. Yushkevich (*Theory Probab. Appl.* **22**, *215-235,1977*). In this talk, we will report our progress on the finite horizon optimality, and show our solutions to some of the unsolved problems.

DEGREE DISTRIBUTIONS AND THE CRITICAL SURFACE OF EPIDEMIC SPREADING ON A RANDOM GROWTH NETWORK

Dong HAN *Shanghai Jiao Tong University, PRC.* E-mail: donghan@sjtu.edu.cn
Tze Leung Lai *Stanford University, USA.* E-mail: lait@stanford.edu

Abstract: A continuous-time Markov chain is presented to describe not only the epidemic spreading taking place on a random growing network but also the network growth in the environment of the epidemic spreading. We investigate how the epidemic spreading on the growing network can affect the topology structure (degree distribution) of the growth network. Moreover, we give the expression of critical surface of the epidemic spreading.

LIMIT THEORY OF PRUNING PROCESSES FOR GALTON-WATSON TREES

Hui HE *Beijing Normal University, PRC*, E-mail: hehui@bnu.edu.cn
Matthias Winkel *University of Oxford, UK*

Abstract: Pruning processes $(\mathcal{F}(\theta), \theta \geq 0)$ have been studied separately for Galton-Watson trees and for Lévy trees. In this paper, we establish a limit theory that strongly connects the two studies, thereby solving an open problem by Abraham and Delmas, also formulated as a conjecture by Löhr, Voisin and Winter. Specifically, we show that for any sequence of Galton-Watson forests $(\mathcal{F}_n, n \geq 1)$ in the domain of attraction of a Lévy forest $\mathcal{F}$, suitably scaled pruning processes converge with respect to the Skorohod topology on cadlag functions with values in the

space of (isometry classes of) locally compact real trees. We separately treat pruning at nodes and edges.

STOCHASTIC DE GIORGI ITERATION AND REGULARITY OF STOCHASTIC PARTIAL DIFFERENTIAL EQUATIONS

Elton P. HSU *Northwestern University, USA and USTC, China*, E-mail: ehsu@math.northwestern.edu

Abstract: We consider uniformly elliptic stochastic partial differential equation with progressively measurable random diffusion coefficients. The traditional method is not suitable for treating this type of SPDEs. De Giorgi iteration is a well known method for elliptic PDEs with measurable coefficients. We discuss a stochastic version of this method and show that it is very well adapted to SPDEs with random diffusion coefficients. We illustrate this method by showing almost sure Holder regularity of solutions of a class of SPDEs.

DENSITY CONVERGENCE FOR SOME NONLINEAR GAUSSIAN STATIONARY SEQUENCES

Yaozhong HU *University of Kansas*, E-mail: yhu@ku.edu
David NUALART *University of Kansas*
Samy TINDEL *University Nancy I*
Fangjun XU *East China Normal University*

Abstract: Consider a Gaussian stationary sequence with unit variance $X = \{X_k; k = 0, 1, 2, \cdots\}$ and a weighted sum of the form $V_n = n^{-1/2} \sum_{k=0}^{n-1} f(X_k)$, where f designates a finite sum of Hermite polynomials. Under some mild assumption involving the causal representation of X we show that the distributions of the random variables V_n have smooth densities ρ_n. Assume that the central limit theorem holds for V_n. Then we prove that the uniform convergence of the density of V_n towards the standard Gaussian density also holds true. Namely,

$$\lim_{n\to\infty} \sup_{x\in\mathbf{R}} |\rho_n(x) - \phi(x)| = 0\,,$$

where $\phi(x) = (2\pi)^{-1/2} e^{-x^2/2}$ is the normal density. The rate of convergence is also obtained. This is a joint work with Samy Tindel, David Nualart and Fangjun Xu.

LAW OF LARGE NUMBERS FOR SOME MARKOV CHAINS ALONG NON HOMOGENOUS GENEALOGIES

Vincent Bansaye *Ecole Polytechnique, France*
Chunmao HUANG *Harbin institute of technology at Weihai*, E-mail: cmhuang@hitwh.edu.cn

Abstract: We consider a population with non-overlapping generations, whose size goes to infinity. It is described by a discrete genealogy which may be time non-homogeneous and we pay special attention to branching trees in varying environments. A Markov chain models the dynamic of the trait of each individual along this genealogy and it may also be time non-homogeneous. We want to determine the evolution of the distribution of the traits among the population, namely the asymptotic behavior of the proportion of individuals with a given trait. In this talk, we show some laws of large numbers which rely on the ergodicity of an auxiliary process. A central limit is also established.

VARIANCE REDUCTION FOR DIFFUSIONS

Chii-Ruey HWANG, *Institute of Mathematics, Academia Sinica, Taibei*, E-mail: crhwang@sinica.edu.tw
Raoul Normand, Yonghui Huang,

Abstract: The most common way to sample from a probability distribution is to use Monte-Carlo methods. For distributions on a continuous state space, one can find diffusions with the target distribution as equilibrium measure, so that the state of the diffusion after a long time provides a good sample from the desired distribution. There exist many diffusions with a common equilibrium, and one would naturally like to choose those that make the convergence to equilibrium faster. One way to do this is to consider reversible diffusion, and add to it an anti-symmetric drift which preserves the invariant measure. It has been proven that, in general, the irreversible algorithm performs better than the reversible one, in that the spectral gap is larger. In the present work, asymptotic variance is used as the criterion to compare these algorithms. We first provide a general comparison result, and then apply it to the specific cases of a diffusion on d-dimensional Euclidean space, or on a compact Riemannian manifold. We prove that, in general, adding an anti-symmetric drift to a reversible diffusion reduces the asymptotic variance. We also provide some extensions of this result concerning strict inequality, the worst-case analysis, and the behavior of the asymptotic variance when the drift goes to infinity.

ITÔ FORMULA FOR GENERALIZED WHITE NOISE FUNCTIONALS, REVISTED

Yuh-Jia LEE
University of Kaohsiung, Kaohsiung, Taiwan, E-mail: yuhjialee@gmail.com

Abstract: Without the definition of Itô integral, we are able to derive "Itô's formula". In the proof we show that the Hitsuda-Skorokhod integral arisen naturally. In this talk we shall show that the Hitsuda-Skorokhod integral may be defined for any Gaussian and Non-Gaussian Lévy functionals. Some new Iô type integral which are connected with Hitsuda-Skorokhod will be discussed.

MARKOV BASES IN ALGEBRAIC STATISTICS

Benchong LI *Xidian University, PRC*, E-mail: libc580@gmail.com

Abstract: Algebraic statistics is a relatively new field that has developed and changed rather rapidly over the last twenty years. Markov basis, which represents a connection between commutative algebra and statistics, is of key importance to exact test of a contingency table. In this

presentation, first, the basics of contingency tables, exact tests and Metropolis-Hastings algorithm are reviewed. The correctness of this algorithm is guaranteed by the theory of stationary distributions of Markov chains. Secondly, the notion of a Markov basis is introduced, and then the problem of computing Markov bases is addressed using tools in algebraic geometry. Next, some recent results in this field are presented, which involves part of our work. Finally, summary and future research problems are listed.

FIRST PASSAGE OF FRACTIONAL-DERIVATIVE STOCHATIC SYSTEMS WITH POWER-FORM RESTORING FORCE

Wei LI *Xidian University, PRC*, E-mail: liweilw@mail.xidian.edu.cn

Abstract: First-passage is one branch of reliability in stochastic dynamical systems which can estimate fatigue life of certain structure such as offshore platform, civil constructions and so on. Based on stochastic averaging method, Fourier expansion and finite difference method, first-passage of systems with fractional derivative damping and power-form restoring force subjected to Gaussian white-noise excitation is studied. Numerical results shows that reliability function is affected by both the order of fractional derivative and the value of safe boundary. Moreover, the analytical results are agreement with Monte-Carlo simulation.

ON THE GENERALIZED SOLUTION OF THE NAVIER-STOKES EQUATIONS VIA OPTIMAL TRANSPORTATION

Xiang-Dong LI *AMSS, Chinese Academy of Sciences, China*, E-mail: xdli@amt.ac.cn

Abstract: In 1965, V.I. Arnold [1] introduced the L^2-Riemannian metric on the group of volume-preserving diffeomorphisms and proved that the incompressible Euler equation is a geodesics with respect to this metric. In 1999, Y. Brenier [2] used the theory of optimal transportation to study the generalized solution to the Euler equation. Recently, M. Arnaudon and A. B. Cruzeiro [3] proved that the incompressible Navier-Stokes equation can be realized as the Euler-Lagrangian equation of the Nelson type kinetic energy on the group of volume-preserving diffeomorphisms. In this talk, we present our recent work [4] on the study of generalized solution of the Navier-Stokes equations via the optimal transportation.

References

[1] Arnold, V.I. Sur la géeométrie différentielle des groupes de Lie de dimension infinie et ses applications à l'hydrodynamique des uides parfaits, Ann. Inst. Fourier 16 316-361 (1966).

[2] Brenier, Y. Minimal geodesics on groups of volume-preserving maps and generalized solutions of the Euler equations. Comm. Pure Appl. Math. 52, 411-452 (1999).

[3] Arnaudon, M., Cruzeiro, A. B. Lagrangian Navier-Stokes diffusions on manifolds: Variational principle and stability, Bull. Sci. Math. 136 no. 8, 857-881 (2012).

[4] Li, Songzi, Li, Xiang-Dong, Liu, Guo-Ping. On the generalized solution to incompressible Navier-Stokes equations via optimal transportation, work in progress.

ASYMPTOTIC PROPERTIES OF SUPERCRITICAL BRANCHING PROCESSES IN RANDOM ENVIRONMENTS

Quansheng LIU *Univ. de Bretagne - Sud (Univ. of South Brittany, France) and Changsha Univ. of Science and Technology (China)* , E-mail: quansheng.liu@univ-ubs.fr

Abstract: We consider a supercritical branching process (Z_n) in an independent and identically distributed random environment ξ, and present some recent results on the asymptotic properties of the branching process. In particular, we show a criterion for the existence of weighted moments of the limit variable W of the normalized population size $W_n = Z_n/\mathbb{E}[Z_n|\xi]$, and limit theorems (such as moderate and large deviations principles) on $(\log Z_n)$.

ON THE EIGENFUNCTIONS OF THE COMPLEX ORNSTEIN-UHLENBECK OPERATORS AND APPLICATIONS

Yong Chen *Hunan University of Science and Technology*, E-mail: zhishi@pku.org.cn
Yong LIU *Peking University, China*, E-mail: liuyong@math.pku.edu.cn,

Abstract: In this talk, we show that the complex Hermite polynomials are the eigenfunctions of complex Ornstein-Uhlenbeck operators, and obtain a product formula of Hermite polynomials. Using this formula, we give the relation between real Wiener-Itô chaos and the complex Wiener-Itô chaos (or: multiple integrals). As an application, we prove the fourth moment theorem (or say: the Nualart-Peccati criterion) for the complex Wiener-Itô multiple integrals.

[1] Chen Y., Liu Y., On the eigenfunctions of the complex Ornstein-Uhlenbeck operators, *Kyoto J. Math.*, Vol. 54(3), 577-596, (2014).

[2] Chen Y., Liu Y., On the fourth moment theorem for the complex multiple Wiener-Itô integrals, *Preprint* (2014)

PERTURBATION ANALYSIS FOR CONTINUOUS-TIME MARKOV CHAINS

Yuanyuan LIU *Central South University, PRC*, E-mail: liuyy@csu.edu.cn

Abstract: We investigate perturbation for continuous-time Markov chains (CTMCs). The explicit bounds on ΔD and D are derived in terms of a drift condition, where Δ and D represent the perturbation of the intensity matrices and the deviation matrix, respectively. Moreover, we obtain the perturbation bounds on the stationary distributions, which extend the results in Liu (2012) for uniformly bounded CTMCs to general (possibly unbounded) CTMCs. Our arguments are mainly based on the technique of the augmented truncation.

QUASI-INVARIANCE OF THE STOCHASTIC FLOW ASSOCIATED TO ITÔ'S SDE WITH SINGULAR TIME-DEPENDENT DRIFT

Dejun LUO *Institute of Applied Mathematics, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, PRC*, E-mail: luodj@amss.ac.cn

Abstract: In this paper we consider the Itô SDE

$$\mathrm{d}X_t = \mathrm{d}W_t + b(t, X_t)\,\mathrm{d}t, \quad X_0 = x \in \mathbb{R}^d,$$

where W_t is a d-dimensional standard Wiener process and the drift coefficient $b : [0,T]\times\mathbb{R}^d \to \mathbb{R}^d$ belongs to $L^q(0,T;L^p(\mathbb{R}^d))$ with $p \geq 2, q > 2$ and $\frac{d}{p} + \frac{2}{q} < 1$. In 2005, Krylov and Röckner (Probab. Theory Related Fields, 2005) proved that the above equation has a unique strong solution X_t. Recently it was shown by Fedrizzi and Flandoli (Stoch. Anal. Appl., 2013) that the solution X_t is indeed a stochastic flow of homeomorphisms on $\mathbb{R}^d$. We prove in this talk that the Lebesgue measure is quasi-invariant under the flow X_t.

ON THE HITTING TIMES OF CONTINUOUS-STATE BRANCHING PROCESSES WITH IMMIGRATION

Xan Duhalde *Université Paris 06, France*, Clément Foucart *Université Paris 13, France*,

Chunhua MA *Nankai University, PRC*, E-mail: mach@nankai.edu.cn

Abstract: We study a two-dimensional joint distribution related to the first passage time below a level for a continuous-state branching process with immigration. We provide an explicit expression of its Laplace transform and obtain a necessary and sufficient criterion for transience or recurrence. We follow the approach of Shiga, T. (1990) for Ornstein-Uhlenbeck type processes by finding some λ-invariant functions for the generator.

LIMIT THEOREMS FOR SOME CRITICAL SUPERPROCESSES

Yan-Xia REN *Peking University, PRC*, E-mail: yxren@math.pku.edu.cn
Renming Song *University of Illinois, USA*
Rui Zhang *Peking University, PRC*

Abstract: In this talk I will present some conditional limit theorems for some critical superprocesses $X = \{X_t; t \geq 0\}$. The first result is about the rate of non-extinction. The next result says that, for a large class of functions f, conditioned on non-extinction at time t, the limit, as $t \to \infty$, of $t^{-1}\langle f, X_t\rangle$ exists in distribution. Finally, we also establish, under some conditions, a central limit theorem for $\langle f, X_t\rangle$ conditioned on non-extinction at time t.

MEAN-FIELD BACKWARD STOCHASTIC DIFFERENTIAL EQUATIONS WITH SUBDIFFERRENTIAL OPERATOR AND ITS APPLICATIONS

Yong REN *Anhui Normal University, China*
joint with Wen Lv and Lanying Hu

KEY WORDS: Mean-field backward stochastic differential equation; Subdifferrential operator; Yosida approximation; McKean-Vlasov equation; Viscosity solution

MATHEMATICAL SUBJECT CLASSIFICATION: 60H10, 60G40, 60H30

Abstract: In this talk, I will introduce a class of mean-field backward stochastic differential equations with subdifferrential operator corresponding to a lower semi-continuous convex function. By means of Yosida approximation, the existence and uniqueness of the solution is established. As an application, the probability interpretation for the viscosity solutions of a class of nonlocal parabolic variational inequalities is given. Some well-known results are extended.

RECURRENT PROPERTIES OF REGIME-SWITCHING DIFFUSIONS

Jinghai SHAO: *Beijing Normal University, Beijing, P.R.China*, Email:shaojh@bnu.edu.cn

Abstract: Regime-switching diffusion processes can be viewed as diffusion processes in random environments characterized by continuous-time Markov chains. Their recurrent properties are rather complicated. In this talk, we introduce several criteria to justify their recurrent properties based on separatively the theory of non-singular M-matrix, Perron-Frobenius theorem and principal eigenvalues of bilinear forms. These criteria enable us to study the recurrent properties of regime-switching diffusions with infinite countable switching and non-linear coefficients.

IDENTIFYING THE LIMITING DISTRIBUTION

Qi-Man SHAO *The Chinese University of Hong Kong*, E-mail: qmshao@cuhk.edu.hk

Abstract: For a given sequence of random variables of interest, we shall develop a general approach to identify the limiting distribution by Stein's method. The accuracy of the approximation will also be discussed.

WEAK CONVERGENCE TO THE ROSENBLATT SHEET

Guangjun SHEN *Anhui Normal University, PRC*, E-mail: gjshen@163.com

KEY WORDS: Rosenblatt sheet, martingale differences, Poisson process, random walks, weak convergence

Abstract: In this talk, we study the problem of the approximation in law of the Rosenblatt sheet. We prove the convergence in law of three families of process to the Rosenblatt sheet: the first one is martingale differences, the second one constructed from a Poisson process in the plane and the third one is the random walks. This is a joint work with Litan Yan, Xiuwei Yin, Dongjin Zhu

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CONVERGENCE ON THE APPROXIMATION OF PATH-DEPENDENT FUNCTIONALS

Qingshuo SONG *City University of Hong Kong*, E-mail: qingsong@cityu.edu.hk

Abstract: This work focuses on the convergence analysis of the approximation methods in Monte Carlo simulations. In contrast to the traditional approach, this work establishes a general framework for the convergence analysis based on actual estimation under the Skorohod topology.

MINIMAL THINNESS FOR LÉVY PROCESSES

Panki Kim *Seoul National University, Korea*
Renming SONG *University of Illinois, USA*, E-mail: rsong@math.uiuc.edu.
Zoran Vondracek *University of Zagreb, Croatia*

Key words: minimal thinness, subordinate Brownian motion, Lévy processe, boundary Harnack principle, Green function, Martin boundary

Mathematical Subject Classification: 60J50, 31C40, 31C35, 60J45, 60J75

Abstract: Minimal thinness is a notion that describes the smallness of a set at a boundary point. In this talk, I will present some recently obtained criteria for minimal thinness at finite and infinite minimal Martin boundary points for a large class of purely discontinuous symmetric Lévy processes.

BIRTH AND DEATH PROCESS WITH BOUNDED JUMPS IN RANDOM ENVIRONMENT

Hua-Ming WANG *Department of Mathematics, Anhui Normal University, Wuhu 241003, China* E-mail: hmking@mail.ahnu.edu.cn

Abstract: In this talk, we give an introduction of Birth and Death Process (BDP for short) with bounded jumps in random environment based on our recent works [3, 4, 5] enumerated below. Firstly, we study BDP with one-side bounded jumps on positive half lattice in fixed environment. Criteria for recurrence and positive recurrence are presented at first. For the positively recurrent case, based on the branching structure for (L,1) random walk constructed in [1], we formulate the explicit form of the stationary distribution of the process. Secondly, we study BDP with bounded jumps in random environment, say $\{N_t\}_{t\geq 0}$. Sufficient conditions for the existence and criteria for the recurrence of the process are given at first. Then by an argument known as "the environment viewed from particle", we derive the Law of Large Numbers (LLN for short) for the h-skeleton process $\{N_{nh}\}_{n\geq 0}$, which is indeed a discrete time random walk with unbounded jumps in random environment. The LLN for $\{N_t\}_{t\geq 0}$ is also proved by using the LLN of $\{N_{nh}\}_{n\geq 0}$. We mention that, by taking advantage of the branching structure for random walk with bounded jumps constructed in [2], the asymptotic velocity of the LLN for $\{N_t\}_{t\geq 0}$ is given explicitly.

References

[1] Hong, W. M. and Wang, H. M., Intrinsic branching structure within (L-1) random walk in random environment and its applications, Infin. Dimens. Anal. Quantum Probab. Relat. Top., Vol. 16, 1350006 [14 pages], 2013

[2] Hong W. M., and Wang H. M., Intrinsic branching structure within random walk on Z, Teor. Veroyatnost. i Primenen., Vol. 58(4), 730-751, 2013; English version will appear in Theory of Probability and Its Applications, 2014

[3] Wang, H. M., Birth and death process with one-side bounded jumps in random environment, arXiv:1407.3385, 2014

[4] Wang, H. M., Birth and death process with bounded jumps in random environment, arXiv:1406.6222, 2014

[5] Wang, H. M., Stationary distribution for birth and death process with one-side bounded jumps, arXiv:1407.4007, 2014

EXPONENTIAL CONTRACTIVITY IN THE L^p-WASSERSTEIN DISTANCE FOR STOCHASTIC DIFFERENTIAL EQUATIONS WITH JUMPS

Dejun Luo *Academy of Mathematics and Systems Science, PRC*
Jian WANG *Fujian Normal University, PRC*, E-mail: jianwang@fjnu.edu.cn

Abstract: By adopting the coupling by reflection and the coupling of marching soldiers for a class of stochastic differential equations with jumps, we establish the exponential contractivity of the associated semigroups $(P_t)_{t\geq 0}$ with respect to the standard L^p-Wasserstein distance for all $p \in [1, \infty)$. In particular, consider the following stochastic differential equation

$$dX_t = dZ_t + b(X_t)\, dt,$$

where $(Z_t)_{t\geq 0}$ is symmetric α-stable process on R^d with $\alpha \in (1, 2]$. We show that if the drift term b satisfies that for any $x, y \in R^d$,

$$\langle b(x) - b(y), x - y\rangle \leq \begin{cases} K_1|x-y|^2, & |x-y| \leq L; \\ -K_2|x-y|^\theta, & |x-y| > L \end{cases}$$

holds with some positive constants K_1, K_2, $L > 0$ and $\theta \geq 2$, then there is a constant $\lambda > 0$ such that for all $p \in [1, \infty)$, $t > 0$ and $x, y \in R^d$ with $|x - y| \leq 1$,

$$W_p(\delta_x P_t, \delta_y P_t) \leq C(p, \theta)e^{-\lambda t/p}|x-y|^{1/p};$$

for all $p \in [1, \infty)$, $t > 0$ and $x, y \in R^d$ with $|x - y| > 1$,

$$W_p(\delta_x P_t, \delta_y P_t) \leq C(p, \theta)e^{-\lambda t/p} \begin{cases} |x-y|, & \theta = 2; \\ |x-y| \wedge \frac{1}{t\wedge 1}, & \theta > 2. \end{cases}$$

ON A CLASS OF SKEW DIFFUSION PROCESSES

Yongjin WANG *Nankai University, PRC*, E-mail: yjwang@nankai.edu.cn

Abstract: In this talk, the so-called skew Brownian motion is addressed and then we will discuss some typical classes of skew diffusion processes. With some dedicate performance, we are able to get explicit results for the first passage times of the skew O-U processes and of skew Feller-branching processes as well.

QUASI-REGULAR DIRICHLET FORMS ON RIEMANNIAN LOOP SPACES

Bo WU: *School of Mathematical Sciences, Fudan University, Shanghai 200433, China*, E-mail: wubo@fudan.edu.cn
Xin Chen *Department of Mathemetics, Shanghai Jiao Tong University, Shanghai 200240, China*

Key words: Dirichlet form, closability, quasi-regularity, loop space

Mathematical Subject Classification: 60H07

Abstract: In this talk, we construct a large class of quasi-regular local Dirichlet forms on loop spaces over a stochastically complete, non-compact Riemannian manifold. And these Dirichlet forms are quasi-regular and thus, the corresponding diffusion processes are well-constructed by the theory of Dirichlet forms.

Main References

[1] B. K. Driver, M. Röckner(1992), Construction of diffusions on path and loop spaces of compact Riemannian manifolds, C. R. Acad. Sci. Paris Séries, **I 315**, 603–608

[2] J.-U. Löbus(2004), A class of processes on the path space over a compact Riemannian manifold with unbounded diffusion, *Tran. Ame. Math. Soc.*, **356** 3751-3767

[3] F. Y. Wang, B. Wu(2008), Quasi-Regular Dirichlet Forms on Riemannian Path and Loop Spaces, *Forum Math.*, **20**, 1085–1096

[4] X. Chen, B. Wu(2014), Functional inequality on path space over a non-compact Riemannian manifold, *J. Funct. Anal.*, **266** 6753-6779

ON THE PATH-INDEPENDENCE OF GIRSANOV DENSITY FOR INFINITE-DIMENSIONAL STOCHASTIC DIFFERENTIAL EQUATIONS

Jiang-Lun WU *Department of Mathematics, Swansea University, UK*, E-mail: j.l.wu@swansea.ac.uk

KEY WORDS: Infinite-dimensional stochastic differential equations, Galerkin approximation, Girsanov density, characterisation theorem.

MATHEMATICAL SUBJECT CLASSIFICATION: 60H10, 60H30

Abstract: Starting from the characterisation of path-independence of Girsanov density for (finite-dimensional) stochastic differential equations, this talk will address a new link of infinite-dimensional stochastic differential equations to certain nonlinear parabolic equations in infinite-dimensional spaces, in which we obtain a characterisation of path-independent property of stochastic differential equations in infinite-dimensions. The talk is based on a joint paper with Miao Wang and a forthcoming work with Feng-Yu Wang.

References

[1] A. Truman, F.-Y. Wang, J.-L. Wu & W. Yang (2012). A link of stochastic differential equations to nonlinear parabolic equations, *SCIENCE CHINA Mathematics*, **55**, 1971-1976.

[2] M. Wang & J.-L. Wu (2014). Necessary and sufficient conditions for path-independence of Girsanov transformation for infinite-dimensional stochastic evolution equations, *Frontiers of Mathematics in China*, **9**, 601-622.

[3] F.-Y. Wang & J.-L. Wu (2014+). On the path-independence of Girsanov transform density for infinite-dimensional stochastic differential equations, in preparation.

A NEW LOWER BOUND FOR THE THRESHOLD OF THE RANDOM 3-SAT MODEL

Xianyuan, WU *Capital Normal University, PRC*, E-mail: wuxy@cnu.edu.cn

Feng, WANG *Capital Normal University, PRC*

Abstract: In this report, we will introduce our recent work on the Random 3-SAT model. Actually, we prove that a random 3-SAT formulate with clause to variables ratio less than 2.793 is satisfiable with high probability. Our result comes from the second moment method, with changes of measure and optimization. It is believed that the threshold of the random 3-SAT model is near 4.2, and the former best lower bound is 2.68 given in [1].

Reference

[1] D. Achlioptas and Y. Peres (2004): *The Threshold for Random k-SAT is* $2^k \log 2 - O(k)$*;* Journal of the American Mathematical Society, Vol 17, No. 4, pp 947-973

A LINEAR-QUADRATIC OPTIMAL CONTROL PROBLEM OF FORWARD-BACKWARD STOCHASTIC DIFFERENTIAL EQUATIONS WITH PARTIAL INFORMATION

Jie XIONG *University of Macau, PRC*, E-mail: jiexiong@umac.mo
KEY WORDS: Linear-quadratic control, Forward-backward stochastic differential equation, Partial information, Correlated state and observation noise, Closed-form solution

MATHEMATICAL SUBJECT CLASSIFICATION: 93E11, 93E20, 60H10

Abstract: In this talk, we will present an approach to study a linear-quadratic optimal control problem of forward-backward stochastic differential equations, where observation coefficient is linear with respect to state x, and observation noise is correlate with state noise. Two optimality conditions and a feedback representation of optimal control are derived. Closed-form optimal solutions are obtained in some particular cases. As an application of the optimality conditions, an example of generalized recursive utility is explicitly solved. This talk is based on a joint paper with Wang and Wu.

References

[1] G.C. Wang, Z. Wu and J. Xiong (2013). A linear-quadratic optimal control problem of forward-backward stochastic differential equations with partial information. Conditionally accepted by *IEEE Transactions on Automatic Control*.

DERIVATIVE FOR THE INTERSECTION LOCAL TIME OF FRACTIONAL BROWNIAN MOTIONS

Litan YAN *Donghua University, PRC*, E-mail: litanyan@dhu.edu.cn

Abstract: Let $B^{H_i} = \{B_t^{H_i}, t \geq 0\}$, $i = 1, 2$ be two independent fractional Brownian motions on $\mathbb{R}$ with respective indices $H_i \in (0, 1)$ and $H_1 \leq H_2$. In this paper, we consider their intersection local time $\{\ell_t(a), t \geq 0, a \in \mathbb{R}\}$. We show that $\ell_t(a)$ is differentiable in the spatial variable a and we introduce the so-called *hybrid quadratic covariation* $[f(B^{H_1} - B^{H_2}), B^{H_1}]^{(HC)}$. When $H_1 < \frac{1}{2}$, we construct a Banach space $\mathscr{H}$ of measurable functions such that the quadratic covariation exists in $L^2(\Omega)$ for all $f \in \mathscr{H}$, and the Bouleau-Yor type identity

$$[f(B^{H_1} - B^{H_2}), B^{H_1}]_t^{(HC)} = -\int_{\mathbb{R}} f(a)\ell_t(da)$$

holds. When $H_1 \geq \frac{1}{2}$, we show that the quadratic covariation exists also in $L^2(\Omega)$ for some Hölder functions f and the above Bouleau-Yor type identity holds.

THE PATHWISE UNIQUENESS OF SOLUTION TO A SPDE DRIVEN BY α-STABLE NOISE

Xu YANG *Beifang University of Nationalities, Yinchuan, PRC.* E-mail: xuyang@mail.bnu.edu.cn

Abstract: In this talk we study the pathwise uniqueness of solution to the following stochastic partial differential equation

$$\frac{\partial X_t(x)}{\partial t} = \frac{1}{2}\Delta X_t(x) + X_{t-}(x)^{\beta}\dot{L}_t(x), \quad t > 0,\ x \in \mathbb{R},$$

where $1 < \alpha < 2$, $0 < \beta < 1$ and $\dot{L}$ denotes an α-stable white noise on $\mathbb{R}_+ \times \mathbb{R}$ without negative jumps. In the special case of $\alpha\beta = 1$, where solution to the above equation is the density of a super-Brownian motion with α-stable branching (see Mytnik (2002)), our result leads to its pathwise uniqueness for $1 < \alpha < 4 - 2\sqrt{2}$. The local Hölder continuity of the solution is also obtained for fixed time $t > 0$ and $\alpha\beta \neq 1$.

This talk is based on a joint work with Xiaowen Zhou.

SOME RESULTS ON CERTAIN STOCHASTIC PREDATOR-PREY MODELS

G. YIN *Wayne State University, Detroit, MI 48202, USA*, E-mail: gyin@math.wayne.edu

Abstract: We study stochastic predator-prey systems with emphases on asymptotic properties. We obtain sufficient and almost necessary conditions for permanence and ergodicity of the stochastic predator-prey models with Beddington-DeAngelis functional response. Both non-degenerate and degenerate diffusions are considered. One of the distinctive aspects of this work is that it characterizes the support of the corresponding invariant probability measures. [This is a joint work with N.H. Du (Hanoi National University) and N.H. Dang (Wayne State University)].

HYPERCONTRACTIVITY, COMPACTNESS, AND EXPONENTIAL ERGODICITY FOR FUNCTIONAL STOCHASTIC DIFFERENTIAL EQUATIONS

Chenggui YUAN *Swansea University, UK*, E-mail: C.Yuan@Swansea.ac.uk
Jianhai Bao *Central South University, PRC*, E-mail: jianhaibao13@gmail.com
Feng-Yu Wang *Beijing Normal University, PRC*, E-mail: wangfy@bnu.edu.cn

Abstract: An explicit sufficient condition on the hypercontractivity is derived for the Markov semigroup associated to a class of functional stochastic differential equations. Consequently, the semigroup P_t converges exponentially to its unique invariant probability measure μ in both $L^2(\mu)$ and the totally variational norm, and it is compact in $L^2(\mu)$ for large $t > 0$. This provides a natural class of non-symmetric Markov semigroups which are compact for large time but non-compact for small time. A semi-linear model which may not satisfy this sufficient condition is also investigated.

QUASI-STATIONARY DISTRIBUTIONS AND THEIR APPLICATIONS

Hanjun ZHANG *School of Mathematics and Computational Science, Xiangtan University, P. R. China.*,
E-mail: hjz001@xtu.edu.cn
Key words: quasi-stationary distribution; domain of attraction; interesting particle system

Mathematical Subject Classification: 60J25; 37A25; 60B10.

Abstract: Let us begin with the talk by recalling the key three questions of quasi-stationary distributions (QSDs); and then we shall talk about many new progresses on above the key three questions of QSDs. Finally, we shall discuss the applications of QSDs; especially, we shall talk about how to apply the QSD's results in the interesting particle system etc.

STOCHASTIC DIFFERENTIAL EQUATIONS WITH SOBOLEV COEFFICIENTS AND APPLICATIONS

Xicheng ZHANG *Wuhan University, PRC*, E-mail: XichengZhang@whu.edu.cn

Abstract: In this work we study the properties of solutions to stochastic differential equations with Sobolev diffusion coefficients and singular drifts such as: the stability with respect to the coefficients, weak differentiability with respect to the starting point, and the Malliavin differentiability with respect to the sample path. We also establish the Bismut-Elworthy-Li's formula. As applications, we use a stochastic Lagrangian representation to Navier-Stokes equations given by Constantin-Iyer to prove the local well-posedness of NSEs in R^d with initial values in the first order Sobolev space $W_p^1(R^d)$ provided $p > d$.

LAPLACE TRANSFORMS OF OCCUPATION TIMES FOR SPECTRALLY NEGATIVE LÉVY PROCESSES

Xiaowen ZHOU *Concordia University, Canada*

Key words: Lévy processes, occupation time

Mathematical Subject Classification: 60J00

Abstract:

Spectrally negative Lévy processes (SNLP) are Lévy processes with no positive jumps. Many results on Brownian motion can be extended to SNLP via possibly different approaches. In this talk we present an approach to find several Laplace transforms of occupation times for SNLP. These Laplace transforms are expressed in terms of scale functions for the associated SNLP.

This talk is based on joint work with Yingqiu Li and Na Zhu.

Participants: (in order of the surname)

Jianhai Bao:
Central South University, Changsha.
E-mail: jianhaibao13@gmail.com

Lijun Bo:
Xidian University, Xi'an.

Dayue Chen:
School of Mathematical Sciences, Peking University, Beijing.
E-mail: dayue@math.pku.edu.cn

Mu-Fa Chen:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: mfchen@bnu.edu.cn

Jinwen Chen:
Tsinghua University, Beijing.
E-mail: jchen@math.tsinghua.edu.cn

Xin Chen:
Shanghai Jiao Tong University, Shanghai.
E-mail: chenxin_217@hotmail.com

Zhen-Qing Chen:
University of Washington, USA.
E-mail: zqchen@uw.edu

Tzuu-Shuh Chiang:
Institute of Mathematics, Academia Sinica, Taibei.
E-mail: matsch@math.sinica.edu.tw

Yunshyong Chow:
Institute of Mathematics, Academia Sinica, Taibei.
E-mail: chow@math.sinica.edu.tw

Weijuan Chu:
Nanjing University, Nanjing.

Congzao Dong:
Xidian University, Xi'an.

Zhao Dong:
Institute of Applied Mathematics, Chinese Academy of Sciences, Beijing.
E-mail: dzhao@amt.ac.cn

Shui Feng:
McMaster University, Canada.
E-mail: shuifeng@mcmaster.ca

Fuqing Gao:
Wuhan University, Wuhan.
E-mail: fqgao@whu.edu.cn

Fu-Zhou Gong:
Chinese Academy of Sciences, Beijing.
E-mail: fzgong@amt.ac.cn

Xianping Guo:
Sun Yat-Sen University, Guangzhou.
E-mail: mcsgxp@mail.sysu.edu.cn

Dong Han:
Shanghai Jiao Tong University, Shanghai.
E-mail: donghan@sjtu.edu.cn

Guoman He:
Xiangtan University, Xiangtan.

Hui He:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: hehui@bnu.edu.cn

Xin He:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: hexin@bnu.edu.cn

Wenming Hong:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: wmhong@bnu.edu.cn

Elton P. Hsu:
Northwestern University, USA.
E-mail: elton@math.northwestern.edu

Shulan Hu:
Zhongnan University of Economics and Law, Wuhan.

Yaozhong Hu:
University of Kansas, USA.
E-mail: hu@math.ku.edu

Chunmao Huang:
Harbin institute of technology, Harbin.
E-mail: cmhuang@hitwh.edu.cn

Hailan Huang:
Xiangtan University, Xiangtan.

Chii-Ruey Hwang:
Academia Sinica, Taibei.
E-mail: crhwang@sinica.edu.tw

Yuh-Jia Lee:
University of Kaohsiung, Kaohsiung.
E-mail: yuhjialee@gmail.com

Benchong Li:
Xidian University, Xi'an.
E-mail: libc580@gmail.com

Huaiqian Li:
Sichuan University, Chengdu.

Wei Li:
Xidian University, Xi'an.
E-mail: liweilw@mail.xidian.edu.cn

Xiang-Dong Li:
Institute of Applied Mathematics, Chinese Academy of Sciences, Beijing.
E-mail: xdli@amt.ac.cn

Yingqiu Li:
Changsha University of Science and Technology, Changsha.
E-mail: liyq-2001@163.com

Zenghu Li:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: lizh@bnu.edu.cn

Zhongwei Liao:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: zhwliao@mail.bnu.edu.cn

Guoping Liu:
Institute of Applied Mathematics, Chinese Academy of Sciences, Beijing.

Quansheng Liu:
Universite de Bretagne- Sud, France.
E-mail: Quansheng.Liu@univ-ubs.fr

Wei Liu:
Wuhan University, Wuhan .

Yong Liu:
School of Mathematical Sciences, Peking University, Beijing.
E-mail: liuyong@math.pku.edu.cn

Yuanyuan Liu:
Central South University, Changsha.
E-mail: liuyy@csu.edu.cn.

Dejun Luo:
Institute of Applied Mathematics, Chinese Academy of Sciences, Beijing.
E-mail: luodj@amss.ac.cn

Chunhua Ma:
Nankai University, Tianjin.
E-mail: mach@nankai.edu.cn

Yutao Ma:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: mayt@bnu.edu.cn

Yonghua Mao:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: maoyh@bnu.edu.cn

Jun Peng:
Central South University, Changsha.
E-mail: pengjun0825@163.com

Xiangyang Peng:
Xiangtan University, Xiangtan.

Xuhui Peng:
Chinese Academy of Sciences, Beijing.
E-mail: pengxuhui@amss.ac.cn

Bin Qian:
Changshu Institute of Technology, Changshu.

Yan-Xia Ren:
School of Mathematical Sciences, Peking University, Beijing.
E-mail: yxren@math.pku.edu.cn

Yong Ren:
Anhui Normal University, Wuhu.
E-mail: renyong@126.com

Jinghai Shao:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: shaojh@bnu.edu.cn

Qi-Man Shao:
Chinese University of Hong Kong, HK.
E-mail: qmshao@cuhk.edu.hk

Guangjun Shen:
Anhui Normal University, Wuhu.
E-mail: gjshen@163.com

Qingshuo Song:
City University of Hong Kong, HK.
E-mail: qingsong@cityu.edu.hk

Renming Song:
University of Illinois, USA.
E-mail: rsong@math.uiuc.edu

Feng Wang:
Capital Normal Unversity, Beijing .

Feng-Yu Wang:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: wangfy@bnu.edu.cn

Hua-Ming Wang:
Anhui Normal University, Wuhu.
E-mail: hmking@mail.ahnu.edu.cn

Jian Wang:
Fujian Normal University, Fuzhou.
E-mail: jianwang@fjnu.edu.cn

Pengfei Wang:
Central South University, Changsha.

Xiaoqiang Wang:
Shandong University, Weihai.

Xinyu Wang:
Huazhong University of Science and Technology, Wuhan.

Yingzhe Wang:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: wangyz@bnu.edu.cn

Yongjin Wang:
Nankai University, Tianjin.
E-mail: yjwang@nankai.edu.cn

Yuzhao Wang:
Chinese Academy of Sciences, Beijing .

Bo Wu:
Fudan University, Shanghai.
E-mail: wubo@fudan.edu.cn

Fuke Wu:
Huazhong University of Science and Technology, Wuhan.
E-mail: wufuke@hust.edu.cn

Jiang-Lun Wu:
Swansea University, UK.
E-mail: j.l.wu@swansea.ac.uk

Xian-Yuan Wu:
Capital Normal Unversity, Beijing.
E-mail: wuxy@mail.cnu.edu.cn

Yingchao Xie:
Jiangsu Normal University, Xuzhou.
E-mail: ycxie@xznu.edu.cn

Yongxiao Xie:
Chinese Academy of Sciences, Beijing.

Jie Xiong:
University of Macau, Macau and University of Tennessee, USA.
E-mail: jiexiong@umac.mo

Litan Yan:
Donghua University, Shanghai.
E-mail: litanyan@dhu.edu.cn

Hui Yang:
Beijing Normal University, Beijing.
E-mail: yanghui2011@mail.bnu.edu.cn

Junfeng Yang:
Nanjing Audit University, Nanjing.
E-mail: jordanjunfeng@163.com

Xiaochuan Yang:
Université Paris-Est, France.
E-mail: xiaochuan.yang@u-pec.fr

Xu Yang:
Beifang University of Nationalities, Yinchuan.
E-mail: xuyang@mail.bnu.edu.cn

George Yin:
Wayne State University, USA.
E-mail: gyin@math.wayne.edu

Chenggui Yuan:
Swansea University, UK.
E-mail: C.Yuan@swansea.ac.uk

Jianliang Zhai:
University of Science and Technology of China, Hefei.
E-mail: zhaijl@ustc.edu.cn

Chi Zhang:
Ocean University of China, Qingdao.
E-mail: chizhang@mail.bnu.edu.cn

Hanjun Zhang:
Xiangtan University, Xiangtan.
E-mail:hjz001@xtu.edu.cn

Mei Zhang:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: meizhang@bnu.edu.cn

Xicheng Zhang:
Wuhan University, Wuhan.
E-mail: xichengzhang@googlemail.com

Yuhui Zhang:
School of Mathematical Sciences, Beijing Normal University, Beijing.
E-mail: zhangyh@bnu.edu.cn

Zhengliang Zhang:
Wuhan University, Wuhan.

Xiaowen Zhou:
Concordia University, Canada.
E-mail: xzhou@mathstat.concordia.ca

Yixia Zhu:
Xiangtan University, Xiangtan.
E-mail: zhuyixia62@163.com