The 8th Workshop on Markov Processes and Related Topics

July 16-18, 2012

Lecture Room 1124, New Library Building (后主楼)

Beijing Normal University

July 20-21, 2012

Wuyi Mountain Villa, Fujian Province

Fujian Normal University

Organizers: Mu-Fa Chen(BNU), Huo-Nan Lin (FJNU), Jian Wang (FJNU)

Sponsors: Key Laboratory of Mathematics and Complex Systems of Ministry of Education, Beijing Normal University; School of Mathematics and Computer Science, Fujian Normal University

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Website: http://math.bnu.edu.cn/probab/Workshop2012

	July 16	July 17	July 18	July 20	July 21
	08:20-08:30 Welcome talk			08:20-09:00 Opening	
Chairman	**M. F. Chen**	**J. Fill**	**Z. H. Li**	**R. M. Song**	**W. B. Li**
08:30-09:00	S. G. Peng	S. J. Sheu	G. Yin		J. Fill
09:00-09:30	S. Feng	X. Y. Wu	F. Z. Gong	I. Shigekawa	X. Chen
09:30-10:00	A. Winter	F. Baudoin	Tea break	J. Xiong	X.P. Guo
10:00-10:30	Take picture	Tea break	D. Y. Chen	Tea break	Tea break
10:30-11:00	Y. Q. Zhao	H. Z. Zhao	A. Y. Chen	F. Q. Gao	Z. H. Li
11:00-11:30	J. M. Wang	D. J. Luo		J. H. Bao	J. Wang
Chairman	**S. J. Sheu**	**A. Y. Chen**		**S. Z. Fang**	**H. N. Lin**
14:30-15:00	T. J. Zhang	Y. Z. Hu		Q. M. Shao	L. M. Wu
15:00-15:30	Y. X. Ren	X. W. Zhou		Z. Dong	R. M. Song
15:30-16:00	Y. J. Wang	J. H. Shao		Y. T. Ma	Tea break
16:00-16:30	Tea break	Tea break		Tea break	S. Z. Fang
16:30-17:00	F. Y. Wang	J. L. Wu		Z. Q. Chen	W. B. Li
17:00-17:30	C. Ouyang	Y. Liu		G. Uribe Bravo	

July 16

Chairman: Mu-Fa Chen

08:20-08:30 Welcome talk

08:30-09:00 Shige Peng (Shandong University)

09:00-09:30 Shui Feng (McMaster University)

Transition functions of a Fleming-Viot process and a random time change

09:30-10:00 Anita Winter (Universität Duisburg-Essen)

Tree valued spatial Λ-cannings dynamics

10:00-10:30 Take picture & Tea break

10:30-11:00 Yiqiang Q. Zhao (Carleton University)

Tail asymptotics for two-dimensional reflecting Brownian motion — a kernel method

11:00-11:30 Jieming Wang (Beijing Institute of Technology)

Perturbation by non-local operators

Chairman: Shuenn-Jyi Sheu

14:30-15:00 Tusheng Zhang (University of Manchester)

Existence and uniqueness of invariant measures for Spdes with two reflecting walls

15:00-15:30 Yan-Xia Ren (Peking University)

Weak extinction versus global exponential growth of total mass for superdiffusions corresponding to the operator $Lu + \beta u - ku^2$

15:30-16:00 Yongjin Wang (Nankai University)

The hitting problems for a class of reflected O-U processes

16:00-16:30 Tea break

16:30-17:00 Feng-Yu Wang (Beijing Normal University)

Integration by parts formula and shift Harnack inequality for stochastic equations

17:00-17:30 Cheng Ouyang (University of Illinois at Chicago)

Some functional inequalities for SDEs driven by fractional Brownian motions

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July 17

Chairman: James Allen Fill

08:30-09:00 Shuenn-Jyi Sheu (National Central University)

The resolvents of drift-accelerated diffusions

09:00-09:30 Xian-Yuan Wu (Capital Normal University)

Large deviation behavior for the longest head run in IID Bernoulli sequence

09:30-10:00 Fabrice Baudoin (Purdue University)

Functional inequalities for subelliptic diffusion operators via curvature bounds

10:00-10:30 Tea break

10:30-11:00 Huaizhong Zhao (Loughborough University)

Random periodic solution of SDEs and SPDEs

11:00-11:30 Dejun Luo (Chinese Academy of Sciences)

Generalized stochastic flow associated to the Itô SDE with partially Sobolev coefficients and applications

Chairman: Anyue Chen

14:30-15:00 Yaozhong Hu (University of Kansas)

Convergence in density of some nonlinear Gaussian functionals

15:00-15:30 Xiaowen Zhou (Concordia University)

Some support properties of Λ-Fleming-Viot process with Brownian mutation

15:30-16:00 Jinghai Shao (Beijing Normal University)

Measure-valued continuous curves and processes in total variation norm

16:00-16:30 Tea break

16:30-17:00 Jiang-Lun Wu (Swansea University)

Path independent property of the action functionals for stochastic dynamical systems

17:00-17:30 Yong Liu (Peking University)

On time regularity of generalized Ornstein-Uhlenbeck processes with cylindrical stable noise

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July 18

Chairman: Zenghu Li

08:30-09:00 George Yin (Wayne State University)

Switching diffusion processes

09:00-09:30 Fuzhou Gong (Chinese Academy of Sciences)

Ergodicity and asymptotic stability of Feller semigroups on Polish spaces

09:30-10:00 Tea break

10:00-10:30 Dayue Chen (Peking University)

The voter model in a random environment in Z^d

10:30-11:00 Anyue Chen (University of Liverpool)

Asymptotic behavior of extinction probability of interacting branching collision processes

July 20

08:20-09:00	Opening & Take picture
	Chairman: Renming Song
09:00-09:30	Ichiro Shigekawa (Kyoto University)
	Exponential convergence of Markov processes
09:30-10:00	Jie Xiong (University of Macau and University of Tennessee)
	Large deviation principle for some measure-valued processes
10:00-10:30	Tea break
10:30-11:00	Fuqing Gao (Wuhan University)
	Moderate deviations for random matrices
11:00-11:30	Jianhai Bao (Swansea University)
	Bismut formulae and applications for functional SPDEs
	Chairman: Shizan Fang
14:30-15:00	Qi-Man Shao (Hong Kong University of Science and Technology)
	Cramér type moderate deviations for self-normalized processes
15:00-15:30	Zhao Dong (Chinese Academy of Sciences)
15:30-16:00	Yutao Ma (Beijing Normal University)
	Uniform logarithmic Sobolev inequalities in dimension for harmonic measures on spheres
16:00-16:30	Tea break
16:30-17:00	Zhenqing Chen (University of Washington)
	From generalized Nash inequality to off-diagonal upper bound estimate
17:00-17:30	Gerónimo Uribe Bravo (Instituto de Matematicas, UNAM)
	Generalized time-change and continuous-state branching processes with immigration

July 21

Chairman: Wenbo Li

08:30-09:00 James Allen Fill (The Johns Hopkins University)

Comparison inequalities and fastest-mixing Markov chains

09:00-09:30 Xia Chen (University of Tennessee)

Quenched asymptotics for Brownian motion in generalized Gaussian potential

09:30-10:00 Xianping Guo (Zhongshan University)

Linear programming and constrained average optimality for continuous-time Markov decision processes in Polish spaces

10:00-10:30 Tea break

10:30-11:00 Zenghu Li (Beijing Normal University)

Stochastic equations and Lamperti transformations

11:00-11:30 Jian Wang (Fujian Normal University)

Functional inequalities for stable-like Dirichlet forms

Chairman: Huo-Nan Lin

14:30-15:00 Liming Wu (Chinese Academy of Sciences)

Transport inequality on graphs

15:00-15:30 Renming Song (University of Illinois)

Heat kernel estimates for relativistic stable processes

15:30-16:00 Tea break

16:00-16:30 Shizan Fang (Institute of Mathematic of Bourgogne)

Sobolev estimates for optimal transportations

16:30-17:00 Wenbo Li (University of Delaware)

Negative moments for branching processes

Bismut Formulae and Applications for Functional SPDEs

Jianhai BAO *Swansea University, UK*, E-mail: J.BAO.536390@swansea.ac.uk

Abstract: By using Malliavin calculus, explicit derivative formulae are established for a class of semi-linear functional stochastic partial differential equations with additive or multiplicative noise. As applications, gradient estimates and Harnack inequalities are derived for the semigroup of the associated segment process.

This is a joint work with Feng-Yu Wang and Chenggui Yuan.

Functional Inequalities for Subelliptic Diffusion Operators via Curvature Bounds

Fabrice BAUDOIN *Purdue University, USA*, E-mail: fbaudoin@math.purdue.edu

Abstract: In this talk I shall review some recent results that were obtained by the authors in joint works with M. Bonnefont, N. Garofalo and B. Kim. Let L be a symmetric and subelliptic diffusion operator defined on a manifold M. By using the curvature dimension inequality proposed by Baudoin-Garofalo we will discuss the following properties of L that are usually addressed in a Riemannian framework by using Ricci lower bounds:

- Boundedness of the Riesz transform;
- Existence of log-Sobolev inequalities;
- Existence of isoperimetric and Gaussian isoperimetric inequalities.

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Asymptotic Behavior of Extinction Probability of Interacting Branching Collision Processes

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Junping Li *Central South University, China*

KEY WORDS: Markov Branching Processes, Interacting Branching Collision Processes, Extinction Probability, Asymptotic Behavior.

MATHEMATICAL SUBJECT CLASSIFICATION: 60J27; 60J35

Abstract: Although the exact expressions for the extinction probability of Interacting Branching Collision Process (IBCP) have been given recently, see Chen et al [1], these expressions are sometimes very complicated and thus quite informative, particularly regarding the asymptotic behavior. In this talk, the latter problem will be addressed in detail. We shall show that for large n, the extinction probability (a_n) is proportional to $n^\alpha q^n$ where q is the smallest positive root of $C(s) = 0$ on the interval of $[0, 1]$ and $C(s)$ is the generating function of the rates of the collision component. The interesting quantity α is exactly given which is extremely informative.

References

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The Voter Model in a Random Environment in Z^d

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

Abstract: We consider the voter model with flip rates determined by $(\mu_e, e \in E_d)$, where E_d is the set of all non-oriented nearest-neighbour edges in the Euclidean lattice Z^d. Suppose that $(\mu_e, e \in E_d)$ are i.i.d. random variables satisfying $\mu_e \geq 1$. We prove that when $d = 2$, almost surely for all random environments the voter model has only two extremal invariant measures: δ_0 and δ_1. This is a joint work with Zhichao Shan.

Quenched Asymptotics for Brownian Motion in Generalized Gaussian Potential

Xia CHEN *University of Tennessee, USA*, Email:xchen@math.utk.edu

Key words: generalized Gaussian field, parabolic Anderson model.

Mathematical Subject Classification: 60J65, 60K37, 60K40, 60G55, 60F10.

Abstract:

Recall that the notion of generalized function is introduced for the functions that can not be defined pointwise, and is given as a linear functional over the test functions. The same idea applies to random fields. In this talk, we study the long term asymptotics for the quenched moment

$$E_0 \exp\left\{ \int_0^t V(B_s)ds \right\}$$

consisting of a d-dimensional Brownian motion $\{B(s);\ s \geq 0\}$ and a generalized Gaussian field $V(\cdot)$. The major progress made in this paper includes: Solution to an open problem posted by Carmona and Molchanov with an answer different from what was conjectured; the quenched laws for Brownian motions in Newtonian-type potentials, and in the potentials driven by white noise or by fractional white noise.

References

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From Generalized Nash Inequality to Off-diagonal Upper Bound Estimate

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

Abstract: In their 1987's paper, Carlen, Kusuoka and Stroock extended Davis' method to general symmetric Markov processes and obtained an upper bound transition density function estimate. That formula requires the on-diagonal estimate to be of polynomial decay rate. In this talk, I will report recent progress on the off-diagonal heat kernel upper bound estimates for general symmetric Markov processes that allows non-polynomial on-diagonal decay rates, via generalized Nash inequality.

Sobolev Estimates for Optimal Transportations

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

Key words: Optimal transportation, Sobolev estimates, Gaussian measures, Monge-Ampère equations, Wiener space

Mathematical Subject Classification: 35J60, 46G12, 58E12, 60H07

Abstract: We will give a priori estimates in Sobolev spaces of optimal transportations, with dimension free constants. We will use these results to solve Monge-Ampère equations on the Wiener space.

Transition Functions of a Fleming-Viot Process and a Random Time Change

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

Key words: Gamma process, Dirichlet process, measure-valued branching diffusion with immigration, Fleming-Viot process, random time change.

Mathematical Subject Classification: Primary: 60F10; Secondary: 92D10.

Abstract: In this talk, a random time change is discussed. The transition function of a Fleming-Viot process is derived from the transition function of a measure-valued branching diffusion with immigration through the time change. This is a joint work with Fang Xu.

References

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Comparison Inequalities and Fastest-mixing Markov Chains

James Allen FILL *The Johns Hopkins University, USA*, E-mail: jimfill@jhu.edu
Jonas KAHN *Université de Lille, France*, E-mail: jonas.kahn@math.univ-lille1.fr

KEY WORDS: Markov chains, comparison inequalities, fastest mixing, stochastic monotonicity, log-concave distributions, birth-and-death chains

MATHEMATICAL SUBJECT CLASSIFICATION: 60J10

Abstract: We introduce a new partial order on the class of stochastically monotone Markov kernels having a given stationary distribution π on a given finite partially ordered state space $\mathcal{X}$. When $K \preceq L$ in this partial order we say that K and L satisfy a *comparison inequality.* We establish that if $K_1, \dots, K_t$ and $L_1, \dots, L_t$ are reversible and $K_s \preceq L_s$ for $s = 1, \dots, t$, then $K_1 \cdots K_t \preceq L_1 \cdots L_t$. In particular, in the time-homogeneous case we have $K^t \preceq L^t$ for every t if K and L are reversible and $K \preceq L$, and using this we show that (for suitable common initial distributions) the Markov chain Y with kernel K mixes faster than the chain Z with kernel L, in the strong sense that *at every time* t the discrepancy—measured by total variation distance or separation or L^2-distance—between the law of Y_t and π is smaller than that between the law of Z_t and π.

Using comparison inequalities together with specialized arguments to remove the stochastic monotonicity restriction, we answer a question of Persi Diaconis by showing that, among all symmetric birth-and-death kernels on the path $\mathcal{X} = \{0, \dots, n\}$, the one (we call it the *uniform chain*) that produces fastest convergence from initial state 0 to the uniform distribution has transition probability 1/2 in each direction along each edge of the path, with holding probability 1/2 at each endpoint.

We also use comparison inequalities

(i) to identify, when π is a given log-concave distribution on the path, the fastest-mixing stochastically monotone birth-and-death chain started at 0, and

(ii) to recover and extend a Peres–Winkler result that extra updates do not delay mixing for monotone spin systems.

Among the fastest-mixing chains in (i), we show that the chain for uniform π is slowest in the sense of maximizing separation at every time.

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Ergodicity and Asymptotic Stability of Feller Semigroups on Polish Spaces

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Yuan Liu *Institute of Applied Mathematics, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing 100190, China, Beijing*

Key words: ergodicity, asymptotic stability, Feller semigroup, Polish space

Mathematical Subject Classification: primary 60J05; secondary 37A30

Abstract: There exists a long literature of studying the ergodicity and asymptotic stability for various semigroups from dynamic systems and Markov chains. Abundant theories and applications have been established for compact or locally compact state spaces. However, it seems very hard to extend all of them to infinite dimensional or general Polish settings. Actually, the *strong Feller* semigroups were the most popular objects in the field of stochastic processes on Banach spaces. Recent years, people have developed many new approaches to more complicated models. For instance, the *asymptotic strong Feller* property, as a celebrating breakthrough, was presented by Hairer and Mattingly, which can be applied to deal with the uniqueness of ergodicity for 2D Navier-Stokes equations with degenerate stochastic forcing. Some notable contributions to this subject came from Lasota and Szarek along with their sequential works for *equicontinuous* semigroups. Indeed, the equicontinuity is adaptable to many known stochastic partial differential equations at present. However, it seems far from being necessary in the theoretical sense. In this talk, we will give the sharp criterions or equivalent characterizations about the ergodicity and asymptotic stability for *Feller* semigroups on Polish spaces with full generality. To this end we will introduce some new notions, especially the *eventual continuity* of Feller semigroups, which seems very close to be necessary for the ergodic behavior in some sense and also allows the sensitive dependence on initial data in some extent.

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Linear Programming and Constrained Average Optimality for Continuous-Time Markov Decision Processes in Polish Spaces

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Yonghui Huang, Zhongshan University, China, E-mail: hyongh5@mail.sysu.edu.cn
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Key words: Continuous-time Markov decision process, unbounded transition rate, average criterion, linear program, constrained optimal policy

Mathematical Subject Classification: 90C40, 60J27

This talk concerns with the constrained average optimality for continuous-time Markov decision processes in Polish spaces, in which policies can depend on *histories*. The optimality criterion to be optimized is expected average costs, multiple constraints are imposed on similar expected average costs. Under suitable conditions on transition rates and cost functions, the existence of a constrained optimal policy and a linear program for solving a constrained optimal policy are shown. Finally, a cash flow model is used to illustrate the applications of the main results.

References

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Convergence in Density of Some Nonlinear Gaussian Functionals

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Fei Lu *University of Kansas, USA*
David Nualart *University of Kansas, USA*

Key words: Convergence in density, multiple itô-Wiener integrals, Malliavin calculus, Ornstein-Uhlenbeck processes, least squares estimator.

Abstract: The central limit theorem states that If $X_1, \cdots, X_n, \cdots$ are iid then

$$F_n := \sqrt{n}\left(\frac{X_1 + \cdots + X_n}{n} - E(X_1)\right) \quad \text{converges in disribution to a normal random variable}\,.$$

This convergence also holds for some other random sequences F_n such as those given by multiple integrals with respect to Brownian motion ([2], [3]). We study the problem of when the random variable F_n has density $f_n(x)\,, x \in R$ and when the densities $f_n(x)$ converges in L^p to the normal density $\phi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$. We also applied our general results to least squares estimator for Ornstein-Uhlenbeck processes ([1]). The tool to use is Malliavin calculus. This is an ongoing joint work with Fei Lu and David Nualart.

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Negative Moments for Branching Processes

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Abstract: Consider the Galton-Watson branching process $(Z_n)_{n\geq 0}$ with offspring distribution $(p_k)_{k\geq 0}$ starting with $Z_0 = 1$. In the super critical case, i.e. $m = \sum_{k\geq 0} p_k > 1$, Estimates for $E(h(Z_n)Z_n^{-\gamma}$ as $n \to \infty$ are given for slowly varying monotone function h, together with applications to deviation estimates of Z_{n+1}/Z_n.

Stochastic Equations and Lamperti Transformations

Zenghu LI *School of Mathematical Sciences, Beijing Normal University, PRC*,
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Abstract: Two important classes of Markov processes, continuous-state branching processes and positive self-similar processes, can be constructed from Lévy processes by Lamperti transformations. A drawback of those transformations is that they only work for Markov process having zero as a trap. We review some recent results on strong solutions of stochastic equations, which can be used to construct Markov processes and extend the range of applications of the Lamperti transformations.

On Time Regularity of Generalized Ornstein-Uhlenbeck Processes with Cylindrical Stable Noise

Yong LIU *School of Mathematical Sciences, Peking University, PRC*,
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Abstract: A necessary and sufficient condition of càdlàg (right continuous with left limits) modification of Ornstein-Uhlenbeck process with cylindrical stable noise in a Hilbert space is given in this talk. Applying this result, some questions in *Time irregularity of generalized Ornstein-Uhlenbeck processes* (C. R. Acad. Sci. Paris, Ser. I 348(2010), 273-276) and *Structural properties of semilinear SPDEs driven by cylindrical stable process* (Probab. Theory Related Fields, 149(2011), 97-137) are answered.

This is a joint work with Jianliang ZHAI.

Generalized Stochastic Flow Associated to the Itô SDE with Partially Sobolev Coefficients and Applications

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

Key words: Di Perna–Lions theory, stochastic differential equation, density estimate, weak differentiability, maximal function

Mathematical Subject Classification: Primary 60H10; secondary 42B25

Abstract: We consider the Itô SDEs with partially Sobolev coefficients. Assuming the exponential integrability of the negative part of the divergence of the drift coefficient and the partial

gradient of the diffusion coefficient with respect to the generalized Cauchy measure, we show the existence, uniqueness and stability of generalized stochastic flows associated to such equations. As an application, we prove the weak differentiability in the sense of measure of the stochastic flow generated by the Itô SDE with Sobolev coefficients.

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Uniform Logarithmic Sobolev Inequalities in Dimension for Harmonic Measures on Spheres

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Abstract: In this paper, using the method of Barthe-Zhang: reduce multi- dimensional probabilities to one dimensional probabilities, we obtain unifor- m Poincaréinequalities and logarithmic Sobolev inequalities in dimension for harmonic measures on spheres via Muckenhoupt’ s characterization for Poincaréinequalities on real line and Barthe-Roberto’ s characterization for logarithmic Sobolev inequalities on real line.

Some Functional Inequalities for SDEs Driven by Fractional Brownian Motions

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Key words: Concentration, Sobolev inequality, fractional Brownian motions

Mathematical Subject Classification: 60G22, 60D05

Abstract: Concentration property and Log-Sobolev inequalities for stochastic differential equations (SDE) are usually discussed under a Markovian setting for the underlying semi-group of the system. In this talk, we present some results on this direction for some SDEs driven by fractional Brownian motions. In particular, based on our concentration property, we derive a global Gaussian upper bound for the density function of solution to such SDEs.

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Weak Extinction Versus Global Exponential Growth of Total Mass for Super-diffusions Corresponding to the Operator $Lu + \beta u - ku^2$

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KEY WORDS: superdiffusion, superprocess, measure-valued process, gauge theorem, growth bound, weak weak extinction, total mass.

MATHEMATICAL SUBJECT CLASSIFICATION: Primary 60J80; Secondary 60G57, 60J45

Abstract: Consider a superdiffusion X on $\mathbb{R}^d$ corresponding to the semilinear operator $Lu + \beta u - ku^2$, where L is a second order elliptic operator, $\beta(\cdot)$ is in the Kato class, and $k(\cdot) \geq 0$ is nonvanishing and bounded on compact subsets of $\mathbb{R}^d$. Let λ_∞ be the L^∞-growth bound of the semigroup $\{Q_t\}_{t\geq 0}$ corresponding to the Schrödinger operator $L + \beta$. If $\lambda_\infty \neq 0$, then we prove that, in some sense, the exponential growth/decay rate of $\langle 1, X_t \rangle$, the total mass of X_t, is λ_∞. We also describe the limiting behavior of $\exp(-\lambda_\infty t)\langle 1, X_t\rangle$ in these cases. This should be compared to the known result that the generalized principal eigenvalue λ_2 of the operator gives the rate of *local* growth when it is positive, and implies local extinction otherwise. It is easy to show that $\lambda_\infty \geq \lambda_2$, and we discuss cases when $\lambda_\infty > \lambda_2$ and when $\lambda_\infty = \lambda_2$.

When $\lambda_\infty = 0$, and under some conditions on β, we give a sufficient and necessary condition for the superdiffusion X to exhibit weak extinction. We show that the branching intensity k affects weak extinction; this should be compared to the known result that k does not affect weak *local* extinction (which only depends on the sign of λ_2, and which turns out to be equivalent to local extinction) of X.

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Measure-Valued Continuous Curves and Processes in Total Variation Norm

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Abstract: We present several equivalent characterizations of continuous curves in the total variation norm in the space of purely atomic finite measures. This enable us to provide a sufficient condition for a purely atomic finite measure-valued stochastic process to possess a version with continuous sample paths in the total variation norm. This criterion is in the form of Kolmogorov's continuity theorem. As an application, we study the sample path property of finite measure-valued diffusions with immigrations constructed by Shiga (1990).

Cramér Type Moderate Deviations for Self-normalized Processes

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Key words: Moderate deviations, studentized statistics, U-statistics, Hotelling's T^2 statistics

Mathematical Subject Classification: 60F10, 62E20

Abstract: A Cramér type moderate deviation characterizes the relative error of a probability approximation and plays more and more important role in probability theory, statistical inference and multiple hypothesis testing problems. In this talk a moderate deviation theorem for general self-normalized processes will be established and applications to Studentized U-statistics and Hotelling's T^2 statistics will be discussed. The talk is based on joint work with Wenxin Zhou and Weidong Liu.

The Resolvents of Drift-accelerated Diffusions

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Key words: Diffusion Process; Resolvent; Generator; Dirichlet Form

Mathematical Subject Classification: 60H30,60J60,60J35

Abstract: We consider diffusion processes with growing divergence free drifts. The limit of resolvent family is a selfadjoint pseudo-resolvent. This is shown to be the resolvent for a Hunt processes on some path space. This is a joint work with Brice Franke.

Exponential Convergence of Markov Processes

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Key words: logaritmic Sobolev inequality, spectrum, Markov processes

Mathematical Subject Classification: 60J25

Abstract: Let $\{T_t\}$ be a Markovian semigroup in $L^2(M, m)$. We also assume that its dual $\{T_t^*\}$ is Marikovian. Then $\{T_t\}$ defines a Marikovian semigroup in L^p for any $p \in [1, \infty)$. We assume that μ is an invariant probalility measeure and $T_t 1 = T_t^* 1 = 1$. We are interested in the exponential convergence rate of $T_t f$ to $\int_M f\,dm$ as $t \to \infty$. To be precise, set

$$\gamma_{p \to q} = -\limsup \frac{1}{t} \log \|T_t - m\|_{p \to q}$$

where m stands for an operator $f \mapsto m(f) = \int_M f\,dm$ and $\|\ \|_{p \to q}$ denotes an operator norm from L^p to L^q. We are interested in how $\gamma_{p \to q}$ depends on p and q.

We show that under the assumption of hyper-contractivity of the semigroup, $\gamma_{p \to q}$ does not depend on p and q (p, $q > 1$). Moreover, if we assume the symmetry, we can show that L^p spectrum of the generator are independent of $p > 1$. Without the hyper-contractivity, we can constract an example of which the spectrum depends on p. We can also discuss the convergence rate in the setting of the Zygmund space $L \log L$.

This is a joint work with Seiichiro Kusuoka.

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Heat Kernel Estimates for Relativistic Stable Processes

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Key words: Lévy process, stable process, relativistic stable process, heat kernel, transition density, Green function, exit time, Harnack inequality, parabolic Harnack inequality, boundary Hranack inequality, Lévy system

Mathematical Subject Classification: 60J35, 60J75, 47G20, 47D07

Abstract: For any $m > 0$, a relativistic α-stable process X^m on $\mathbf{R}^d$ with mass m is a Lévy process such that for any $t \geq 0$ and $\xi \in \mathbf{R}^d$

$$E\left[\exp\left(i\xi \cdot (X_t^m - X_0^m)\right)\right] = \exp\left(-t\left(\left(|\xi|^2 + m^{2/\alpha}\right)^{\alpha/2} - m\right)\right).$$

The infinitesimal generator of X^m is

$$m - (-\Delta + m^{2/\alpha})^{\alpha/2}.$$

When $\alpha = 1$, the infinitesimal generator reduces to

$$m - \sqrt{-\Delta + m^2}.$$

This operator was used in studying the stability of matter in physics. Relativistic stable processes are also closely related to the Bessel potential theory.

Recently, a lot of progress has been made in establishing sharp two-sided estimates on the transition densities of relativistic stable processes (or equivalently, Dirichlet heat kernels of $m - (-\Delta + m^{2/\alpha})^{\alpha/2}$) in smooth domains. In this talk I will give a survey of some of these results. This talk is based on joint work with Zhen-Qing Chen and Panki Kim.

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Generalized Time-Change and Continuous-State Branching processes with Immigration

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Abstract: We provide a representation of continuous-state branching processes with immigration by solving a functional equation which can be seen as a generalized time-change. Stability of the solutions is studied and gives, in particular, limit theorems (of a type previously studied by Grimvall, Kawazu and Watanabe, and Li) and a simulation scheme for continuous-state branching processes with immigration.

Integration by Parts Formula and Shift Harnack Inequality for Stochastic Equations

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Abstract: A new coupling argument is introduced to establish Driver's integration by parts formula and shift Harnack inequality. Unlike known coupling methods where two marginal processes with different starting points are constructed to move together as soon as possible, for the new-type coupling the two marginal processes start from the same point but their difference is aimed to reach a fixed quantity at a given time. Besides the integration by parts formula, the new coupling method is also efficient to imply the shift Harnack inequality. Differently from known Harnack inequalities where the values of a reference function at different points are compared, in the shift Harnack inequality the reference function, rather than the initial point, is shifted. A number of applications of the integration by parts and shift Harnack inequality are presented. The general results are illustrated by some concrete models including the stochastic Hamiltonian system where the associated diffusion process can be highly degenerate, delayed SDEs, and semi-linear SPDEs.

A Class of Stochastic Partial Differential Equations for Superprocesses with Interacting Motion and Branching

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Abstract: A class of interacting superprocesses on $\mathbb{R}$, called superprocesses with dependent spatial motion (SDSMs), were introduced and studied in Wang(1998) and Dawson et al.(2001). In the present paper, we extend this model to allow particles moving in $\mathbb{R}$ with dependent branching. We show that under a proper re-scaling, a class of discrete SPDEs for the empirical measure-valued processes generated by branching particle systems subject to the same white noise converge in $L^2(\Omega, F, P)$ to the SPDE for a SDSM and the corresponding martingale problem for the SDSMs is well-posed.

Functional Inequalities for Stable-Like Dirichlet Forms

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Key words: Functional inequalities, stable-like Dirichlet forms, Lyapunov type conditions, subordination

Mathematical Subject Classification: 60J75, 47G20, 60G52

Abstract: Let $V \in C^2(\mathrm{R}^d)$ such that $\mu_V(dx) := e^{-V(x)}\,dx$ is a probability measure, and let $\alpha \in (0,2)$. Explicit criteria are presented for the α-stable-like Dirichlet form

$$D_{\alpha,V}(f,f) := \int_{\mathrm{R}^d\times\mathrm{R}^d} \frac{|f(x)-f(y)|^2}{|x-y|^{d+\alpha}}\,dy\,\mu_V(dx)$$

to satisfy Poincaré-type (i.e., Poincaré, weak Poincaré and super Poincaré) inequalities. As applications, sharp functional inequalities are derived for the Dirichlet form with V having some typical growths. Finally, the main result of [1] on the Poincaré inequality is strengthened.

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Perturbation by Non-Local Operators

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Key words: symmetric stable process, fractional Laplacian, perturbation, non-local operator, integral kernel, positivity, Lévy system, Feller semigroup, martingale problem

Mathematical Subject Classification: Primary 60J35, 47G20, 60J75; Secondary 47D07

Abstract: Suppose that $d \geq 1$ and $0 < \beta < \alpha < 2$. We establish the existence and uniqueness of the fundamental solution $q^b(t, x, y)$ to non-local operators $\mathcal{L}^b = \Delta^{\alpha/2} + \mathcal{S}^b$, where

$$\mathcal{S}^b f(x) := \mathcal{A}(d, -\beta) \int_{\mathbb{R}^d} \left(f(x+z) - f(x) - \langle \nabla f(x), z \mathbb{1}_{\{|z| \leq 1\}} \rangle \right) \frac{b(x,z)}{|z|^{d+\beta}} dz$$

and $b(x, z)$ is a bounded measurable function on $\mathbb{R}^d \times \mathbb{R}^d$ with $b(x, z) = b(x, -z)$ for $x, z \in \mathbb{R}^d$. Here $\mathcal{A}(d, -\beta)$ is a normalizing constant. We show that if $b \geq 0$, then $q^b(t, x, y)$ is a strictly positive continuous function and it uniquely determines a conservative Feller process X^b that has strong Feller property. The Feller process X^b is the unique solution to the martingale problem of $(\mathcal{L}^b, \mathcal{S}(\mathbb{R}^d))$, where $\mathcal{S}(\mathbb{R}^d)$ is the space of tempered functions on $\mathbb{R}^d$. Furthermore, sharp two-sided estimates on $q^b(t, x, y)$ is derived.

This is a joint work with Professor Z.-Q. Chen.

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The Hitting Problems for a Class of Reflected O-U Processes

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Abstract: We consider and re-visit the hitting problems on a class of reflected O-U processes, due to their growing applications in Queueing Systems, Financial Modelings and more disciplines. With some dedicate efforts, we are able to eventually obtain some explicit and practical results for those Laplace transforms of the hitting probablities.

Tree Valued Spatial Λ-Cannings Dynamics

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Key words: Tree-valued Markov process, Cannings model, generalized Fleming-Viot, spatial Λ-coalescent, metric probability space, Gromov-weak topology

Mathematical Subject Classification: 60K35, 60J25

Abstract: We study the evolution of genealogies for interacting spatially structured Λ-Cannings models which are also known as generalized Fleming-Viot processes. These are the limit processes of individual-based population models where individuals carry a type, and are replaced by descendants of possibly very sizable offspring. The spatial interaction is due to migration through geographic space.

We show that the dual to these tree-valued spatial Λ-Cannings dynamics are tree-valued spatial Λ-coalescents, and conclude from here the convergence of the fixed time genealogies to the genealogy of an infinitely old population as time tends to infinity. Depending on the strength of migration the latter consists either of a single or of multiple families.

We then study the populations on large tori in Z^d with $d \geq 2$. Depending on the rescaling we find global features which are universal for all Λ-Cannings dynamics and local features which heavily depend on the measure Λ.

Path Independent Property of the Action Functionals for Stochastic Dynamical Systems

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Key words: Path independent property, Euler-Lagrangian and HJB equations, stochastically integrable systems.

Mathematical Subject Classification: 60J60, 70H99.

Abstract: Path independent property of Girsanov transformation for stochastic differential equations was considered [1]. In this talk, the path independent property of the action functionals for stochastically deformed dynamical systems will be discussed. The obtained result gives a characterization for stochastic integrability for Hamiltonian systems and also clarifies the non integrability for Navier-Stokes systems. This is a joint work with Ana Bela Cruzeiro and Jean-Claude Zambrini.

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Large Deviation Behavior for The Longest Head Run in IID Bernoulli Sequence

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Key words: head-run, large deviation, hitting time, skip-free Markov chain

Mathematical Subject Classification: Primary 62F 10; secondary 60J 10

Abstract: This paper discusses large deviation behavior of the longest perfect head run in i.i.d. Bernoulli sequence. Let $Z_1, Z_2, \ldots$ be an i.i.d. sequence with $P(Z_i = 1) = 1 - P(Z_i = 0) = p = 1 - q$ and S_N be the length of the longest consecutive run of 1's within the first N tosses. The famous Erdös-Rényi law tells that $S_N/\ln N \to \xi(p) := [-\ln p]^{-1}$ almost surely as $N \to \infty$. It is proved in this paper that, while $P[S_N/\ln N \geq \xi(p) + x]$ decays like $N^{-x/\xi(p)}$ for each $x > 0$, $P[S_N/\ln N \leq \xi(p) - x]$ decays like $\exp\{-O(N^{x/\xi(p)})\}$ for $0 < x < \xi(p)$.

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Large Deviation Principle for Some Measure-Valued Processes

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KEY WORDS: Large deviation principle, stochastic partial differential equation, Fleming-Viot process, super-Brownian motion.

MATHEMATICAL SUBJECT CLASSIFICATION: Primary 60F10; Secondary: 60H15, 60J68.

Abstract: We establish a large deviation principle for the solutions of a class of stochastic partial differential equations with non-Lipschitz continuous coefficients. As an application, the large deviation principle is derived for super-Brownian motion and Fleming-Viot process. This talk is based on a paper joint with Fatheddin.

Switching Diffusion Processes

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KEY WORDS: switching diffusion, recurrence, stability, stabilization.

MATHEMATICAL SUBJECT CLASSIFICATION: 60J27, 60J60, 93E15.

Abstract: Numerous problems in control and optimization require the treatment of systems in which continuous dynamics and discrete events coexist. The discrete component is given by a random switching process with a finite state space, and the continuous component is the solution of a stochastic differential equation. Seemingly similar to diffusions, the processes have a number of salient features distinctly different from diffusion processes. In this talk, after reviewing necessary and sufficient conditions for positive recurrence and the existence of unique invariant measure, we study stability and stabilization. Numerical solutions of control and game problems will also be recalled.

Existence and Uniqueness of Invariant Measures for Spdes with Two Reflecting Walls

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Abstract: We consider stochastic partial differential equations with two reflecting walls driven by space-time white noise with non-constant diffusion coefficients under periodic boundary conditions. The existence and uniqueness of invariant measures is established under appropriate conditions. The strong Feller property is also obtained.

Random Periodic Solution of SDEs and SPDEs

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KEY WORDS: Random periodic solutions, stochastic differential equations, stochastic partial differential equations, Wiener Sobolev compact

MATHEMATICAL SUBJECT CLASSIFICATION: 60H10, 60H15, 37H99

Abstract: I will talk about the random periodic solutions of stochastic differential equations driven by sdes and spdes and mathematical tools of infinite horizon integral equations and

Wiener- Sobolev compact embedding that we have developed recently. This is based on recent work with C. Feng.

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Tail Asymptotics for Two-Dimensional Reflecting Brownian Motion — a Kernel Method

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Abstract: In this talk, we consider a semi-martingale reflecting Brownian motion model. Using this model, we show how the kernel method can be applied for exact tail asymptotics in the stationary distribution. We demonstrate how to locate the left-most singular point, and how to determine the detailed behavior of the unknown moment generating function at the left-most singular point. This information is the key for characterizing exact tail asymptotics in terms of a Tauberian-like theorem.

Some Support Properties of Λ-Fleming-Viot Process with Brownian Mutation

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Abstract: The Λ-Fleming-Viot process is a probability-measure-valued process whose dual process involves Λ-coalescent, the coalescent with multiple collisions. For such a process with Brownian spatial motion, it was shown by Blath that it does not allow a compact support as long as the corresponding Λ-coalescent stays infinite. Applying the lookdown construction we can show that the process has a compact support at any fixed positive time given that the Λ-coalescent does not come down from infinity too slowly. We also find an upper bound on the Hausdorff dimension for the support. These results generalize the early results of Dawson and Hochberg on Fleming-Viot process with Kingman coalescent dual. This talk is based on joint work with Huili Liu.

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