The 14th Workshop on Markov Processes and Related Topics

July 16-20, 2018

Sichuan University

Co-Chair: Mu-Fa Chen (BNU), Ze-Chun Hu (SCU)

Local Organizer: Yinshan Chang, Ze-Chun Hu, Ting Ma, Xue Peng

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Website: http://math0.bnu.edu.cn/probab/Workshop2018/

Sign In

Skyline International Grand Hotel (九天国际大酒店)

Time: 10:00-23:00, July 15

	July 16	**July 17**	**July 18**	**July 19**	**July 20**
08:30-09:00	Opening				
Chairman	**Z.H. Li**	**F.-Y. Wang**	**Z.-Q. Chen**	**Z. Vondraček**	**J. Xiong**
08:30-09:00		C.G. Yuan	R.M. Song	X.W. Zhou	X.Chen
09:00-09:30	G. Yin	F.B. Xi	J.M. Wang	C.H. Ma	J.P. Li
09:30-10:00	X.P. Guo	Y. Zhang	H. Ge	Y. Shizawa	Y.Y. Liu
10:00-10:30	Tea break	Take picture	Tea break	Tea break	Tea break
Chairman	**G. Yin**	**Y.X. Ren**	**R.M. Song**	**F.Q. Gao**	**X. Chen**
10:30-11:00	T.S. Zhang	C.-L.Wang	Z.-Q. Chen	Y.X. Ren	A.H. Xia
11:00-11:30	X.X. Chen	H.-M. Wang	Y.H. Zhang	J. Kang	X.Y. Li
11:30-12:00	W.M. Hong	D. Zhang	Q.S. Liu	J. Peng	Y.Q. Li
	Lunch	Lunch	Lunch	Lunch	Lunch
Chairman	**Q.-M. Shao**	**Y.C. Xie**	**C.-L. Wang**	**A.H. Xia**	
14:30-15:00	K.N. Lu	X.D. Li	Y.Z. Hu	X. Zhang	
15:00-15:30	X.C. Zhang	J. Xiong	P. Kim	L.-C. Chen	
15:30-16:00	Y.S. Chang	W. Sun	Y. Ren	C. Zhu	
16:00-16:30	Tea break	Tea break	Tea break	Tea break	
Chairman	**K.N. Lu**	**X.D. Li**	**Y.Z. Hu**	**J.P. Li**	
16:30-17:00	Q.-M. Shao	F.Q. Gao	D. Han	A. Kyprianou	
17:00-17:30	X.-Y. Wu	Z. Vondraček	J.H. Shao	D.L. Li	
17:30-18:00	L.J. Huang	Q. Lu	L. Wresch	X. Yang	

The meeting place is at West 303, College of Mathematics, Sichuan University on the morning of July 17, and in Baiyun Hall of the 7th floor of Skyline International Grand Hotel (九天国际大酒店) for other time.

Breakfast, Lunch and Supper are all in the 3rd floor of Skyline International Grand Hotel.

July 16

Chairman: Mu-Fa Chen , Ze-Chun Hu

08:30-09:00 *OPENING*

Chairman: Zenghu Li

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

Sustainable harvesting policies under long-run average criteria

09:30-10:00 Xianping Guo (Sun Yat-Sen University, Guangzhou)

Constrained continuous-time MDPS on the finite horizon

10:00-10:30 Tea break

Chairman: G. Yin

10:30-11:00 Tusheng Zhang (University of Manchester, UK and University of Science and Technology of China, Hefei)

Small time asymptotics for Brownian motion with measure drift

11:00-11:30 Xinxing Cheng (Shanghai Jiao Tong University, Shanghai)

Some properties of a max-type recursive model

11:30-12:00 Wenming Hong (Beijing Normal university, Beijing)

Minima of time-inhomogeneous branching random walks vs. independent random walks

Chairman: Qi-Man Shao

14:30-15:00 Kenning Lu (Brigham Young University,USA)

TBA

15:00-15:30 Xicheng Zhang (Wuhan University, Wuhan)

Propagation of regularity in L^p-spaces for Kolmogorov type hypoelliptic operators

15:30-16:00 Yinshan Chang (Sichuan University, Chengdu)

The capacity of the range of simple random walks

16:00-16:30 Tea break

Chairman: Kenning Lu

16:30-17:00 Qi-Man Shao (Chinese University of Hong Kong, HK)

Necessary and sufficient conditions for the self-normalized central limit theorem

17:00-17:30 Xian-Yuan Wu (Capital Normal University, Beijing)

On the time constant for last passage percolation on complete graph

17:30-18:00 Lujing Huang (Beijing Normal university, Beijing)

Variational principles of hitting times for non-reversible Markov chains

July 17

Chairman: Feng-Yu Wang

08:30-09:00 Chenggui Yuan (Swansea Universtiy, UK)

Asymptotic log-harnack inequality for stochastic systems of infinite memory

09:00-09:30 Fubao Xi (Beijing Institute of Technology, Beijing)

Stabilization of regime-switching processes by feedback control based on discrete time observations ii: state-dependent case

09:30-10:00 Yuan Zhang (Peking University, Beijing)

Stabilization of DLA in a wedge

10:00-10:30 Tea break

Chairman: Yanxia Ren

10:30-11:00 Chia-Li Wang (National Dong Hwa University, Hualien)

On nash equilibrium self-policy of observable queues

11:00-11:30 Hua-Ming Wang (Anhui Normal University, Wuhu)

On the number of points skipped by a transient (1,2) random walk on the lattice of the positive half line

11:30-12:00 Deng Zhang (Shanghai Jiao Tong University, Shanghai)

Scattering for stochastic nonlinear Schrödinger equations

Chairman: Yingchao Xie

14:30-15:00 Xiangdong Li (AMSS, Chinese Academy of Sciences, Beijing)

Kamanovich-Vershik entropy and splitting theorems on manifolds with $CD(-K, m)$-condition

15:00-15:30 Jie Xiong (Southern University of Science and Technology, Shenzhen)

Particle representations for SPDEs with applications

15:30-16:00 Wei Sun (Concordia University, CA)

Stochastic calculus of semi-Dirichlet forms with application to complement value problem for non-local operators

16:00-16:30 Tea break

Chairman: Xiangdong Li

16:30-17:00 Fuqing Gao (Wuhan University, Wuhan)

Moderate deviations for interacting particle systems

17:00-17:30 Zoran Vondraček (University of Zagreb, Crotia)

On the potential theory of subordinate killed processes

17:30-18:00 Qi Lu (Sichuan University, Chengdu)

Transposition solution to backward stochastic differential equations and their applications

July 18

Chairman: Zhen-Qing Chen

08:30-09:00 Renming Song (University of Illinois at Urbana Champaign, USA)

Well-posedness and long time behavior of singular langevin stochastic differential equations

09:00-09:30 Jieming Wang (Beijing Institute of Technology, Beijing)

The boundary harnack principle for diffusion with jumps in lipschitz domain

09:30-10:00 Hao Ge (Peking University, Beijing)

Anomalous contribution and fluctuation theorems of perturbed diffusion processes

10:00-10:30 Tea break

Chairman: Renming Song

10:30-11:00 Zhen-Qing Chen (University of Washington, USA)

Time-fractional Poisson equations: representation and estimates

11:00-11:30 Yuhui Zhang (Beijing Normal University, Beijing)

Moments of the first hitting times for birth-death processes on trees

11:30-12:00 Quansheng Liu (Universitéde Bretagne- Sud, France)

Precise large deviations asymptotics for products of random matrices

Chairman: Chia-Li Wang

14:30-15:00 Yaozhong Hu (University of Alberta at Edmonton, CA)

On the necessary and sufficient conditions to solve a heat equation with general Additive Gaussian noise

15:00-15:30 Panki Kim (Seoul National University, Korea)

Heat kernel estimates for symmetric jump processes with general mixed polynomial growths

15:30-16:00 Yong Ren (Anhui Normal University, Wuhu)

Stabilization of SDEs driven by G-Brownian motion

16:00-16:30 Tea break

Chairman: Yaozhong Hu

16:30-17:00 Dong Han (Shanghai Jiao Tong University, Shanghai)

Limiting special density of a dynamic nonconservative birth-death Q Matrix

17:00-17:30 Jinghai Shao (Tianjin University, Tianjin)

Weak convergence of Euler-Maruyama's approximation for SDEs under integrability condition

17:30-18:00 Lukas Wresch (Bielefeld University, DE)

Path by path uniqueness of stochastic differential equations

July 19

Chairman: Zoran Vondraček

08:30-09:00 Xiaowen Zhou (Concordia University, CA)

Speeds of coming down from infinity for continuous-state nonlinear branching processes

09:00-09:30 Chunhua Ma (Nankai University, Tianjin)

Extremal behavior of branching processes

09:30-10:00 Yuichi Shiozawa (Osaka University, Japan)

Spread rate of branching brownian motions

10:00-10:30 Tea break

Chairman: Fuqing Gao

10:30-11:00 Yanxia Ren (Peking University, Beijing)

Limit theorems for a class of critical superprocesses with stable branching

11:00-11:30 Jaehoon Kang (Seoul National University, Korea)

Dirichlet heat kernel estimates for unimodal Lévy processes

11:30-12:00 Jun Peng (Central South University，Changsha)

Markov processes with darning and their approximations

Chairman: Aihua Xia

14:30-15:00 Xu Zhang (Sichuan University, Chengdu)

Second-order necessary conditions for stochastic optimal control problems

15:00-15:30 Lung-Chi Chen (Fu Jen Catholic University, Taipei)

Critical two-point function for long-range self-avoiding walks with power-law couplings

15:30-16:00 Chao Zhu (University of Wisconsin-Milwaukee, USA)

A weak convergence approach to inventory control using a long-term average criterion

16:00-16:30 Tea break

Chairman: Junping Li

16:30-17:00 Andreas Kyprianou (University of Bath, UK)

Entrance and exit at infinity for stable jump diffusions

17:00-17:30 Deli Li (Lakehead University, Canada)

New versions of some classical stochastic inequalities

17:30-18:00 Xu Yang (Beifang University of Nationalities, Yinchuan)

Existence and pathwise uniqueness to an spde Driven by colored α-stable noises

July 20

Chairman: Jie Xiong

08:30-09:00 Xia Chen (University of Tennessee, USA)

Parabolic Anderson model with a fractional Gaussian noise that is rough in time

09:00-09:30 Junping Li (Central South University, Changsha)

Asymptotic behaviour of extinction probability of interacting branching collision processes

09:30-10:00 Yuanyuan Liu (Central South University，Changsha)

Singular perturbation analysis for Markov modulated fluid models

10:00-10:30 Tea break

Chairman: Xia Chen

10:30-11:00 Aihua Xia (University of Melbourne, Australia)

On the asymptotic behaviour of the number of renewals via translated Poisson

11:00-11:30 Xinyi Li (University of Chicago, USA)

One-point function estimates for loop-erased random walk in three dimensions

11:30-12:00 Yingqiu Li (Changsha University of Science and Technology, Changsha)

Harmonic moments, large and moderate deviation principles for Mandelbrot's cascade in a random environment

SUSTAINABLE HARVESTING POLICIES UNDER LONG-RUN AVERAGE CRITERIA

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

Abstract: We focus on sustainable harvesting strategies for the predator in a predator-prey system. The objective function is of long-run average per unit time type in the path-wise sense. Ecological systems under environmental noise are usually modeled as stochastic differential equations driven by a Brownian motion to date. Recognizing that the formulation using a Brownian motion is only an idealization, in this paper, it is assumed that the environment is subject to disturbances characterized by a jump process with rapid jump rates. Under broad conditions, it is shown that the systems under consideration can be approximated by a controlled diffusion system. Based on the limit diffusion system, control policies of the original systems are constructed. Such an approach enables us to develop sustainable harvesting policies leading to near optimality. [This is a joint work with Dang Nguyen.]

CONSTRAINED CONTINUOUS-TIME MDPS ON THE FINITE HORIZON

Xianping GUO *Sun Yat-Sen University, China*, E-mail: mcsgxp@mail.sysu.edu.cn
Yonghui Huang, *Sun Yat-Sen University, China*
Yi Zhang, *University of Liverpool, UK*

Abstract: This talk is on the constrained optimality of nonhomogeneous continuous-time Markov decision processes on the finite horizon, in which the transition rates are unbounded and policies can be randomized *history-dependent*. The performance criterion to be optimized is the expected total reward on the *finite horizon*, while N constraints are imposed on similar expected costs. Under suitable conditions, we will show three main results: (a) the class of all the randomized history-dependent policies is equivalent to the class of all randomized Markov policies; (b) every extreme point of the space of performance vectors is generated by a deterministic Markov policy; and (c) there exists a constrained-optimal Markov policy, which is a mixture of no more than $N + 1$ deterministic Markov policies. The arguments of these results are based on a novel characterization of the occupation measures of policies.

SMALL TIME ASYMPTOTICS FOR BROWNIAN MOTION WITH MEASURE DRIFT

Tusheng ZHANG *University of Manchester and USTC*, E-mail:
tusheng.zhang@manchester.ac.uk

Abstract: In this talk, I will present a small time large deviation principle and a Varadhan type small time asymptotics for Brownian motion with drifts which are measures.

SOME PROPERTIES OF A MAX-TYPE RECURSIVE MODEL

Xinxing CHEN *Shanghai Jiao Tong University, China*, E-mail: chenxinx@sjtu.edu.cn

Abstract: We consider a simple max-type recursive model which was introduced in the study of depinning transition in presence of strong disorder by Derrida and Retaux. Our interest is focused on the critical regime, for which we study the extinction probability and the moment generating function. This talk is based on a joint work with Bernard Derrida, Yueyun Hu, Mikhail Lifshits and Zhan Shi.

MINIMA OF TIME-INHOMOGENEOUS BRANCHING RANDOM WALKS VS. INDEPENDENT RANDOM WALKS

Wenming HONG *Beijing Normal University, China*, E-mail: wmhong@bnu.edu.cn

Abstract: Consider a time-inhomogeneous branching random walk, generated by the point process L_n which composed by two independent parts: "branching" offspring X_n with the mean $1 + B/(1+n)^\beta$ and "displacement" ξ_n with a drift $A/(1+n)^{2\alpha}$ for $\beta \in (0,1)$ and $\alpha \in (0, \frac{1}{2})$, where the "branching" offspring is supercritical for $B > 0$ but "asymptotical critical" and the drift of the "displacement" ξ_n is positive for $A > 0$ but "asymptotically " goes to zero as time goes to infinity. We find that the limit behavior of the minima (maxima) position of the branching random walk is sensitive on the "asymptotical" parameter β and α. The behavior of the corresponding independent random walks have been considered as well. This is a joint work with Wanting Hou.

TBA

Kening LU *Brigham Young University, USA*, E-mail: klu@math.byu.edu

Abstract: TBA

EXPLICIT CONVERGENCE RATES FOR SUB-GEOMETRIC ERGODIC MARKOV PROCESSES UNDER SUBORDINATION

Xicheng ZHANG *Wuhan University, China*, E-mail: XichengZhang@gmail.com

Abstract: Consider the following Kolmogorov type hypoelliptic operator

$$\mathcal{L}_t := \sum_{j=2}^n x_j \cdot \nabla_{x_{j-1}} + \mathrm{tr}(a_t \cdot \nabla^2_{x_n})$$

where $n \geq 2$, $x = (x_1, \cdots, x_n) \in (\mathbb{R}^d)^n = \mathbb{R}^{nd}$ and a_t is a time-dependent constant symmetric $d \times d$-matrix that is uniformly elliptic and bounded. Let $\{\mathcal{T}_{s,t}; t \geq s\}$ be the time-dependent

semigroup associated with $\mathcal{L}_t$; that is, $\partial_s \mathcal{T}_{s,t} f = -\mathcal{L}_s \mathcal{T}_{s,t} f$. For any $p \in (1,\infty)$, we show that there is a constant $C = C(p,n,d) > 0$ such that for any $f(t,x) \in L^p(\mathbb{R}\times\mathbb{R}^{nd}) = L^p(\mathbb{R}^{1+nd})$ and every $\lambda \geq 0$,

$$\left\| \Delta_{x_j}^{1/(1+2(n-j))} \int_0^\infty \mathrm{e}^{-\lambda t} \mathcal{T}_{s,t+s} f(t+s,x) \mathrm{d}t \right\|_p \leq C\|f\|_p, \quad j = 1,\cdots,n,$$

where $\|\cdot\|_p$ is the usual L^p-norm in $L^p(\mathbb{R}^{1+nd}; \mathrm{d}s \times \mathrm{dx})$. To show this type of estimates, we first study the propagation of regularity in L^2-space from variable x_n to x_1 for the solution of the transport equation $\partial_t u + \sum_{j=2}^n x_j \cdot \nabla_{x_{j-1}} u = f$. (This is a joint work with Zhen-Qing Chen.)

THE CAPACITY OF THE RANGE OF SIMPLE RANDOM WALKS

Yinshan CHANG *Sichuan University, China*, E-mail: ychang@scu.edu.cn

Abstract: The capacity is certain measurement on the size of the range of a simple random walk which is closely related to the intersection probability of two simple random walks. We prove a weak law of large numbers for the capacity of the range of SRWs on Z4. On Z3, there is no such law of large numbers. The capacity, properly scaled, converges in distribution towards the corresponding quantity for the three dimensional Brownian motion.

NECESSARY AND SUFFICIENT CONDITIONS FOR THE SELF-NORMALIZED CENTRAL LIMIT THEOREM

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

Abstract: Let $X_1, X_2, \cdots$ be a sequence of independent random variables and $S_n = \sum_{i=1}^n X_i$ and $V_n^2 = \sum_{i=1}^n X_i^2$. When the sequence are i.i.d, it is known that the self-normalized sum S_n/V_n converges to a standard normal distribution if and only if $\max_{1\leq i\leq n} |X_i|/V_n \to 0$ in probability and the mean of X_1 is zero. In this talk, sufficient conditions for the self-normalized central limit theorem are obtained for general independent random variables. It is also shown that if $\max_{1\leq i\leq n} |X_i|/V_n \to 0$ in probability, then these sufficient conditions are necessary.

ON THE TIME CONSTANT FOR LAST PASSAGE PERCOLATION ON COMPLETE GRAPH

Xianyuan WU *Capital Normal University, China*, E-mail: wuxy@mail.cnu.edu.cn
Rui Zhu *Capital Normal University, Beijing*

Abstract: This paper focuses on the time constant for last passage percolation on complete graph. Let $G_n = ([n], E_n)$ be the complete graph on vertex set $[n] = \{1, 2, \ldots, n\}$, and i.i.d. sequence $\{X_e : e \in E_n\}$ be the passage times of edges. Denote by W_n the largest passage time among all self-avoiding paths from 1 to n. First, it is proved that W_n/n converges to constant μ, where μ is called the *time constant* and coincides with the *essential supremum* of X_e. Second, when $\mu < \infty$, it is proved that the deviation probability $P(W_n/n \leq \mu - x)$ decays as fast as $e^{-\Theta(n^2)}$, and as a corollary, an upper bound for the variance of W_n is obtained. Finally, when $\mu = \infty$, lower and upper bounds for W_n/n are given.

VARIATIONAL PRINCIPLES OF HITTING TIMES FOR NON-REVERSIBLE MARKOV CHAINS

Lujing HUANG *Beijing Normal University*, E-mail: lujingh@yeah.net

Abstract: We give some new kinds of variational formulas for the first hitting time of non-reversible Markov chain on countable state space. Some comparison theorems are obtained for the non-reversible Markov chain and its corresponding reversible one. As an application, we prove a stronger version of a conjecture from Aldous and Fill.

THE COALESCENCE PROBLEM IN BRANCHING PROCESSES AND ITS APPLICATIONS

Jianhai Bao *Swansea University, UK*
Feng-Yu Wang *Tianjin University, China*
Chenggui YUAN *Department of Applied Mathematics, National Sun Yat-sen University, Taiwan*, E-mail: hongjyyi@gmail.com
Krishna B. Athreya *Department of Mathematics, Iowa State University, Iowa, USA*

Key words: branching processes, coalescence, line of descent, multitype, Bellman-Harris, Galton-Watson, branching random walks

Mathematical Subject Classification: 60J80

Abstract: In this talk, we shall present the asymptotic log-Harnack inequality for several different models of stochastic differential systems with infinite memory: non-degenerate SDEs, Neutral SDEs, semi-linear SPDEs, and stochastic Hamiltonian systems. As applications, the following properties are derived for the associated segment Markov semigroups: asymptotic heat kernel estimate; uniqueness of the invariant probability measure; asymptotic gradient estimate and hence, asymptotically strong Feller property; and asymptotic irreducibility.

References

[1] Bao, J., Wang, F.-Y., Yuan, C., Asymptotic Log-Harnack Inequality and Applications for Stochastic Systems of In

nite Memory, arXiv:1710.01042.

[2] Bao, J.,Wang, F.-Y., Yuan, C., Ergodicity for Neutral Type SDEs with Infinite Length of Memory, arXiv:1805.03431.

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[4] Es-Sarhir, A., von Renesse, Max-K., Scheutzow, M., Harnack inequality for functional SDEs with bounded memory, Electron. Commun. Probab., 14 (2009), 560-565.

[5] Es-Sarhir, A., Scheutzow, M., van Gaans, O., Invariant measures for stochastic functional differential equations with superlinear drift term, Differential Integral Equations, 23 (2010), 189-200.

[6] Hairer, M., Mattingly, J. C., Scheutzow, M., Asymptotic coupling and a general form of Harris' theorem with applications to stochastic delay equations, Probab. Theory Related Fields, 149 (2011), 223-259.

STABILIZATION OF REGIME-SWITCHING PROCESSES BY FEEDBACK CONTROL BASED ON DISCRETE TIME OBSERVATIONS II: STATE-DEPENDENT CASE

Jinghai Shao *Tianjin University, China*
Fubao XI *Beijing Institute of Technology, China*, E-mail: xifb@bit.edu.cn

KEY WORDS: stability, regime-switching, state-dependent, feedback control, discrete-time observations.

MATHEMATICAL SUBJECT CLASSIFICATION: 60H10, 93D15, 60J10.

Abstract: This work investigates the almost sure stabilization of a class of regime-switching systems based on discrete-time observations of both continuous and discrete components. It develops Shao's work [SIAM J. Control Optim., 55(2017), pp. 724–740] in two aspects: first, to provide sufficient conditions for almost sure stability in lieu of moment stability; second, to investigate a class of state-dependent regime-switching processes instead of state-independent ones. To realize these developments, we establish an estimation of the exponential functional of Markov chains based on the spectral theory of linear operator. Moreover, through constructing suitable coupling processes based on Skorokhod's representation of jumping process, we realize the control from up and below of the evolution of state-dependent switching process by state-independent Markov chains. In addition, we also append an explicit construction of the general processes of regime-switching systems based on discrete-time observations.

STABILIZATION OF DLA IN A WEDGE

Yuan ZHANG *Peking University, China*, E-mail: zhangyuan@math.pku.edu.cn

Abstract: We prove a discrete Beurling estimate for the harmonic measure in a wedge in $\mathbf{Z}^2$, and use it to show that Diffusion Limited Aggregation (DLA) in a wedge of angle smaller than

$\pi/4$ stabilizes. This allows to consider the infinite DLA and questions about the number of arms, growth and dimension. I will present some conjectures and open problems. Joint work with Eviatar B. Procaccia and Ron Rosenthal.

ON NASH EQUILIBRIUM SELF-POLICY OF OBSERVABLE QUEUES

Chia-Li WANG *Department of Applied Mathematics, National Dong Hwa University, Taiwan*, E-mail: cwang@gms.ndhu.edu.tw

Abstract: Suppose that arriving customers at a queueing system are heterogeneous in service preference. They first observe the number of customers in the system upon arrival, and then decide to join for service or balk depending on expected personal gain. With a non-decreasing and concave service rate in the number of customers in system, we show that the system has a positive number of deterministic self-interest policies (simply called self-policies), but at most one of those is Nash equilibrium. The necessary and sufficient condition of the self-policy being class dominant is also investigated. On the other hand, for a system without equilibrium self-policy, we show that by adjusting service rates the system can be led to equilibrium. This means, unlike the often discussed pricing scheme, has the merit of incentive compatibility. Finally, we use various criterion of fairness to find appropriate service rate adjustments.

ON THE NUMBER OF POINTS SKIPPED BY A TRANSIENT (1,2) RANDOM WALK ON THE LATTICE OF THE POSITIVE HALF LINE

Hua-Ming WANG *Anhui Normal University, China*, E-mail: hmking@ahnu.edu.cn

Abstract: Consider a transient near-critical (1,2) random walk on the lattice of the positive half line. We give a criterion for the finiteness of the number of the skipped points (the points which are never visited) by the random walk. This result generalizes (partially) the criterion for the finiteness of the number of cutpoints of the nearest-neighbor random walk on the lattice of the positive half line by E. Csáki, A. Földes and P. Révész. [*J. Theor. Probab.* 23: 624-638, 2010.].

SCATTERING FOR STOCHASTIC NONLINEAR SCHRÖDINGER EQUATIONS

Deng ZHANG *Shanghai Jiao Tong University, China*, E-mail: dzhang@sjtu.edu.cn

Abstract: In this talk I will present our recent work on scattering for stochastic nonlinear Schrödinger equations with linear multiplicative noise. In the defocusing case with appropriate range of energy-(sub)critical exponents of nonlinearity, we obtain that the stochastic solutions scatter at infinity in the pseudo-conformal space and in the energy space respectively, under suitable conditions of noises. Moreover, by inputting a large non-conservative noise, we show that the solutions scatter at infinity with high probability for the full energy-subcritical exponents, which indicates the regularization effect of noise on scattering.

KAMANOVICH-VERSHIK ENTROPY AND SPLITTING THEOREMS ON MANIFOLDS WITH $CD(-K, m)$-CONDITION

Xiangdong LI *AMSS, Chinese Academy of Sciences, China*, E-mail: xdli@mat.ac.cn

Abstract: In this talk, I will present some recent results on the splitting theorems using the Kamanovich-Vershik entropy on Riemannian manifolds with $CD(-K, m)$-condition. Joint work with Siqi Jian and Yuzhao Wang.

PARTICLE REPRESENTATIONS FOR SPDES WITH APPLICATIONS

Jie XIONG *Southern University of Science and Technology, China*, E-mail: xiongj@sustc.edu.cn

Abstract: In this talk, I will discuss a few types of representations for the solutions to stochastic partial differential equations using interacting particles governed by stochastic differential equations. If time permit, some applications of such representations will be presented.

STOCHASTIC CALCULUS OF SEMI-DIRICHLET FORMS WITH APPLICATION TO COMPLEMENT VALUE PROBLEM FOR NON-LOCAL OPERATORS

Wei SUN *Concordia University, Canada*, E-mail: wei.sun@concordia.ca

Abstract: First, we introduce the Fukushima type decomposition for Markov processes associated with semi-Dirichlet forms and investigate the related stochastic calculus. Then, we apply them to consider the complement value problem for a class of integro-differential operators. The operators have both local and non-local parts. Under mild conditions, we show that there exists a unique bounded continuous weak solution to the complement value problem. Moreover, we give an explicit probabilistic representation of the solution.

MODERATE DEVIATIONS FOR INTERACTING PARTICLE SYSTEMS

Fuqing GAO *Wuhan University, China*, E-mail: fqgao@whu.edu.cn

Abstract: In this talk, we introduce some results on moderate deviations for Ginzburg-Landau models and zero range processes. We first establish moderate deviations for the empirical density processes by local ergodicity. Moderate deviations for some additive functionals are obtained from the moderate deviations of the empirical density processes. (This talk is based on joint works with Qiaojing Liu.)

ON THE POTENTIAL THEORY OF SUBORDINATE KILLED PROCESSES

Zoran Vondraček *University of Zagreb, Crotia*, E-mail: vondra@math.hr

Abstract: Let Z be an isotropic stable process in the Euclidean space. The process Z is killed upon exiting an open set D and the killed process is then subordinated by an independent γ-stable subordinator, $0 < \gamma < 1$. The resulting process is a Hunt process in D. In this talk, I will discuss several potential theoretical properties of this process such as Harnack inequality for nonnegative harmonic functions, the Carleson estimate, Green function and jumping kernel estimates in smooth sets D, and in particular, the boundary Harnack principle. Surprisingly, it turns out the BHP holds only if $1/2 < \gamma < 1$. This is joint work with Panki Kim and Renming Song.

TRANSPOSITION SOLUTION TO BACKWARD STOCHASTIC DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS

Qi LU *Sichuan University, China*, E-mail: lu@scu.edu.cn

Abstract: Backward stochastic differential equations (BSDEs) play important role in many fields, such as stochastic control theory, mathematical finance, etc. Since the seminal work of Pardoux and Peng, the well-posedness of BSDEs in the sense of adapted solution is extensively studied. Due to the lack of suitable stochastic integration theory, it is impossible to define adapted solution to some kind of BSDEs. Hence, the notion of transposition solution is introduced. In this talk, we survey some recent results on this topic. Further, some applications to stochastic control theory are presented.

WELL-POSEDNESS AND LONG TIME BEHAVIOR OF SINGULAR LANGEVIN STOCHASTIC DIFFERENTIAL EQUATIONS

Renming SONG *University of Illinois, USA*, E-mail: rsong@illinois.edu
Longjie Xier *Jiangsu Normal University, China*

Abstract: In this talk, I will present results from a recent joint paper with Longjie Xie on damped Langevin stochastic differential equations with singular velocity fields. The results includes the the strong well-posedness of such equations and the exponential ergodicity for the unique strong solution.

THE BOUNDARY HARNACK PRINCIPLE FOR DIFFUSION WITH JUMPS IN LIPSCHITZ DOMAIN

Jieming WANG *Beijing Institute of Technology*, E-mail: wangjm@bit.edu.cn

Abstract: For $d \geq 3$ and $0 < \beta < 2$, consider the operator $Ł^{\mathbf{b}} = \sum_{i,j=1}^{d} \frac{\partial}{\partial x_i}\left(a_{ij}(x)\frac{\partial}{\partial x_j}f(x)\right) + b_1 \cdot \nabla + \mathcal{S}^{b_2}$, where a_{ij} satisfies the uniformly ellipticity condition and Hölder condition, the function b_1 belongs to some Kato class and

$$\mathcal{S}^{b_2} f(x) := \int_{\mathbb{R}^d} \left(f(x+z) - f(x) - \nabla f(x) \cdot z 1_{\{|z|\leq 1\}}\right) \frac{b_2(x,z)}{|z|^{d+\beta}} dz,$$

$b_2(x,z)$ is a measurable function on $\mathbb{R}^d \times \mathbb{R}^d$ which is bounded between two positive constants and satisfies $b_2(x,z) = b_2(x,-z)$ for $x, z \in \mathbb{R}^d$. We proved the boundary Harnack principle for the operator $Ł^{\mathbf{b}}$ in Lipschitz domain. This is a joint work with Professor Z.-Q. Chen.

ANOMALOUS CONTRIBUTION AND FLUCTUATION THEOREMS OF PERTURBED DIFFUSION PROCESSES

Hao GE *Peking University, China*, E-mail: haoge@pku.edu.cn

Abstract: The paper considers general diffusion processes taking place on widely separated time scales, presenting a measure-theoretic approach to analyze various general thermodynamic functionals of sample paths that satisfying fluctuation theorems under first-order and second-order perturbations. We find out that the limit of these functionals with odd and even variables fails to be the one directly defined on the limiting diffusion processes after the rapid dimensions have been eliminated. Their difference is called an anomalous term, which turns out to be an exponential martingale in all cases under consideration and satisfies the fluctuation theorems. Sufficient and necessary conditions for the vanishing of these anomalous terms are also derived. Physical applications have been included, especially for the second-order diffusion processes under overdamping limit.

TIME-FRACTIONAL POISSON EQUATIONS: REPRESENTATION AND ESTIMATES

Zhen-Qing Chen *University of Washington and Beijing Institute of Technology*, E-mail: zqchen@uw.edu

Abstract: In this talk, an explicit and recursive representation is presented for the first hitting times of birth-death processes on trees. Based on that, the criteria on ergodicity and strong ergodicity of the processes as well as a necessary condition for exponential ergodicity are obtained.

MOMENTS OF THE FIRST HITTING TIMES FOR BIRTH-DEATH PROCESSES ON TREES

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Key words: birth-death processes on trees, first hitting times, ergodocity

Mathematical Subject Classification: 60J60

Abstract: This talk contains three parts: (1) the existence of SRB measures and their properties for infinite dimensional dynamical systems; (2) The existence of strange attractors with SRB measures for parabolic PDEs undergoing Hopf bifurcations driven by a periodic forcing with applications to the Brusselator; (3) Positive entropy implying the existence of horseshoes for infinite dimensional dynamical systems. This is based on joint works with Wen Huang, Zeng Lian, Qiudong Wang, and Lai-Sang Young.

PRECISE LARGE DEVIATIONS ASYMPTOTICS FOR PRODUCTS OF RANDOM MATRICES

Ion GRAMA *Université de Bretagne -Sud, France*
Quansheng LIU *Université de Bretagne -Sud (Univ. South Brittany), France*, E-mail: quansheng.liu@univ-ubs.fr
Hui XIAO *Université de Bretagne -Sud, France*

Abstract: For a sum S_n of independent random variables Bahadur and Rao (1960) and Petrov (1965) established equivalents for large deviation probabilities $P(S_n > n(q+l))$, where q is fixed and l is vanishing as $n \to \infty$. These milestone results have numerous applications in a variety of problems in pure and applied probability. We obtain analogous statements for the product $G_n := g_n \cdots g_1$, where $(g_n)_{n>1}$ is a sequence of independent and identically distributed $d \times d$ real random matrices. We deal with both the norm $|G_n x|$ for x a starting point on the unit sphere in $\mathbb{R}^d$, and the entries of G_n, for both invertible matrices and positive matrices. As applications we improve previous results on large deviation principles for the norm and the scalar product, and obtain precise large deviations in a local limit theorem.

ON THE NECESSARY AND SUFFICIENT CONDITIONS TO SOLVE A HEAT EQUATION WITH GENERAL ADDITIVE GAUSSIAN NOISE

Yaozhong HU *University of Alberta at Edmonton, Canada* , E-mail: yaozhong@ualberta.ca

Abstract: This talk concerns with the stochastic heat equation with general additive Gaussian noise,

$$\frac{\partial}{\partial t}u(t,x) = \Delta u(t,x) + \dot{W}\,,$$

where $\Delta = \sum_{i=1}^{d} \frac{\partial^2}{\partial x_i^2}$ is the Laplacian in the d-dimensional Euclidean space R^d and $\dot{W} = \frac{\partial^{d+1}}{\partial t \partial x_1 \partial x_d} W$ is a general Gaussian noise with covariance

$$E\left(\dot{W}(s,x)\dot{W}(t,x)\right) = R(s,t)\int_{R^d} e^{\iota(x-y)\xi}\mu(d\xi)\,.$$

We shall derive some necessary and sufficient conditions on the Gaussian noise in order to solve the corresponding stochastic heat equation. More specifically we show the following.

Let

$$K_1|t-(s\wedge s')|^\beta \le |R(t,t)+R(s,s')-R(s,t)-R(t,s')| \le K_2|t-(s\wedge s')|^\beta, \quad 0 \le s,s' < t$$

for some $\beta \in (0, 2]$ and for two constants $K_1, K_2 > 0$. Then the above equation admits a random field solution $\{u(t, x);\, t \geq 0, x \in R^d\}$ if and only if the following conditions is satisfied:

$$\int_{R^d} \frac{1}{1 + |\xi|^{2\beta}} \mu(d\xi) < \infty.$$

The main task is a careful computation of the variance of some stochastic integral with deterministic kernel. This is a joint work with Yanghui Liu and Samy Tindel.

HEAT KERNEL ESTIMATES FOR SYMMETRIC JUMP PROCESSES WITH GENERAL MIXED POLYNOMIAL GROWTHS

Panki KIM *Seoul National University, South Korea*, E-mail: pkim@snu.ac.kr

Abstract: In this talk, we discuss transition densities of pure jump symmetric Markov processes in $\mathbf{R}^d$, whose jumping kernels are comparable to radially symmetric functions with general mixed polynomial growths. Under some mild assumptions on their scale functions, we establish sharp two-sided estimates of transition densities (heat kernel estimates) for such processes. This is the first study on global heat kernel estimates of jump processes (including non-Lévy processes) whose weak scaling index is not necessarily strictly less than 2. As an application, we proved that the finite second moment condition on such symmetric Markov process is equivalent to the Khintchine-type law of iterated logarithm at the infinity. This is a joint work with Joohak Bae, Jaehoon Kang and Jaehun Lee.

STABILIZATION OF SDEs DRIVEN BY G-BROWNIAN MOTION

Yong REN *Anhui Normal University, Wuhu, CHINA*, E-mail: renyong@126.com

Abstract: In this talk, I firstly introduce some preliminaries on G-Itô stochastic analysis. Then, I propose some developments on stabilization of SDEs driven by G-Brownian motion.

LIMITING SPECIAL DENSITY OF A DYNAMIC NONCONSERVATIVE BIRTH-DEATH Q MATRIX

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Abstract: We not only prove the existence and uniqueness of the limiting spectral distribution of a dynamic nonconservative birth-death Q matrix, but also give an integral representation of the limiting spectral density.

WEAK CONVERGENCE OF EULER-MARUYAMA'S APPROXIMATION FOR SDES UNDER INTEGRABILITY CONDITION

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Abstract: This work aims to investigate the weak convergence of Euler-Maruyama's approximation for stochastic differential equations with singular drifts. By using the Harnack inequality, we establish the convergence in weak topology and in the Wasserstein distance when the drifts satisfy certain integrability conditions in lieu of the widely used growth conditions. In addition, when the drifts satisfy certain regularity conditions, we also estimate convergence rate. This method is applicable whatever the diffusion coefficients are non-degenerate or degenerate. A stochastic damping Hamiltonian system is considered as an illustrative example.

Path by path uniqueness of stochastic differential equations

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Abstract: Consider the following SDE in $\mathbb{R}^d$ or a separable Hilbert space

$$\mathrm{d}X_t = -AX_t\mathrm{d}t + f(t, X_t)\mathrm{d}t + \mathrm{d}W_t,$$

where A is a positive, linear operator, f is a bounded Borel measurable function and W a cylindrical Wiener process. If the components of f decay to 0 in a faster than exponential way we establish path by path uniqueness for mild solutions of this SDE. This extends A.M. Davies famous result from $\mathbb{R}^d$ to Hilbert space-valued stochastic differential equations. In this talk we consider the so-called path-by-path approach where the above SDE is considered as a random integral equation with parameter $\omega \in \Omega$. We show that there exists a set Ω' of full measure such that for every $\omega \in \Omega'$ the corresponding integral equation for this ω has exactly one solution. This notion of uniqueness (called path-by-path uniqueness) is much stronger than the usual pathwise uniqueness considered in the theory of SDEs.

SPEEDS OF COMING DOWN FROM INFINITY FOR CONTINUOUS-STATE NONLINEAR BRANCHING PROCESSES

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Abstract:We consider a class of nonlinear continuous-state branching processes which can be obtained from spectrally positive Lévy processes via Lamperti type time transform. Intuitively, they are the branching processes whose branching rates depend on the current population sizes. The extinction, explosion and coming down from infinity behaviors for such processes have been studied in Li (2016) and Li et al. (2017). In this talk we further discuss the small time asymptotic behaviors of the processes. By analyzing Laplace transforms of weighted occupation times and uctuation behaviors for spectrally positive Lévy processes, we solve a one-sided exit problem for the nonlinear branching processes and identify the speeds of coming down from infinity in different scenarios. This talk is based on joint work with Donald Dawson, Clvément Foucart and Pei-Sen Li.

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EXTREMAL BEHAVIOR OF BRANCHING PROCESSES

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

Abstract: We consider a distribution equation which was initially studied by Bertoin [**?**], where he consider the tail distribution of maximum offspring in a critical Galton-Watson branching process. We reprove the tail behaviour of the solution of a generalised equation by calculations. Motivated by this question, we study the extremal behavior of a continuous-state branching process (CSBP) driven by a Lévy process that is regularly varying with index $\alpha > 1$. We show that in the subcritical case the extremal behavior of the CSBP is due to one big jump of the driving Lévy process and its limit measure is given associated with regular variation on the space of càdlàg functions, while in the critical case multiple big jumps are required to make the extreme event happen. This talk is partially based on joint works with XinXin Chen and Wei Xu.

SPREAD RATE OF BRANCHING BROWNIAN MOTIONS

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Abstract: In this talk, we are concerned with the population growth rate outside a ball with time dependent radius for a branching Brownian motion in Euclidean space. Here the splitting time distribution is determined by a certain Kato class measure μ and the offspring distribution is state dependent. We know by [1] that if each particle has at least one child at the splitting time, then the growth rate is determined by the principal eigenvalue λ of the Schrödinger type operator associated with μ and the offspring distribution provided that $\lambda < 0$. We prove that this fact is true even if each particle may have no children at the splitting time. As its corollary, we see that the upper bound of the particle range grows linearly with rate $\sqrt{-\lambda/2}$. We also discuss the upper deviation for the particle range.

LIMIT THEOREMS FOR A CLASS OF CRITICAL SUPERPROCESSES WITH STABLE BRANCHING

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Renming SONG *University of Illinois at Urbana-Champaign, USA*
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Abstract: We consider a critical (ξ, ψ)-superprocess $\{X; \mathbf{P}_\mu\}$. ξ, the spatial motion of the superprocess, is a Hunt process on a locally compact separable metric space E with reference measure m. ψ, the branching mechanism of the superprocess, is a function on $E \times [0, \infty]$ of the form

$$\psi(x, z) = -\beta(x)z + \kappa(x)z^{\gamma(x)}, \quad x \in E, z \geq 0, \tag{1}$$

with $\beta \in \mathcal{B}_b(E)$, $\gamma \in \mathcal{B}_b^+(E)$ and $\kappa \in \mathcal{B}_b^+(E)$ satisfying

$$1 < \gamma(\cdot) < 2; \quad \gamma_0 := \operatorname{ess\,inf}_{m(dx)} \gamma(x) > 1; \quad \operatorname{ess\,inf}_{m(dx)} \kappa(x) > 0. \tag{2}$$

We show that, under some conditions, $\mathbf{P}_{\delta_x}(\|X_t\| \neq 0)$ converges to 0 as $t \to \infty$ and is regularly varying at infinity with index $(\gamma_0 - 1)^{-1}$. Furthermore, if $m(x : \gamma(x) = \gamma_0) > 0$, we show that, for any finite initial measure μ on E,

$$\lim_{t\to\infty} \eta_t^{-1} \mathbf{P}_\mu(\|X_t\| \neq 0) = \langle \phi, \mu \rangle, \tag{3}$$

and for a large class of non-negative testing functions f, as $t \to \infty$,

$$\{\eta_t X_t(f); \mathbf{P}_{\delta_x}(\cdot | \|X_t\| \neq 0)\} \longrightarrow \langle f, \phi^* \rangle_m \mathbf{z}^{(\gamma_0 - 1)}, \quad \text{in law}, \tag{4}$$

where ϕ (ϕ^*, resp.) is the principal eigenfunction of the mean semigroup (the dual of the mean semigroup, resp.) of the superprocess, $\eta_t := \big(C_X(\gamma_0 - 1)t\big)^{-\frac{1}{\gamma_0 - 1}}$, $C_X := \langle \mathbf{1}_{\gamma(\cdot)=\gamma_0} \kappa \phi^{\gamma_0}, \phi^* \rangle_m$ and $\mathbf{z}^{(\gamma_0-1)}$ is a random variable with Laplace transform

$$E[e^{-u\mathbf{z}^{(\alpha)}}] = 1 - (1 + u^{-\alpha})^{-1/\alpha}, \quad u \geq 0. \tag{5}$$

DIRICHLET HEAT KERNEL ESTIMATES FOR UNIMODAL LÉVY PROCESSES

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Abstract: In this talk, we discuss transition density functions for unimodal Lévy processes killed upon leaving an open set D. When the boundary of D is smooth and the characteristic exponent of unimodal Lévy process is in de Haan class at infinity determined by bounded slowly varying function, we obtain two-sided Dirichlet heat kernel estimates for such processes. This is a joint work with Soobin Cho and Panki Kim.

MARKOV PROCESSES WITH DARNING AND THEIR APPROXIMATIONS

Jun PENG *Central South University, China*, E-mail: pengjun2015@csu.edu.cn

Abstract: In this paper, we study darning of general symmetric Markov processes by shorting some parts of the state space into singletons. A natural way to construct such processes is via Dirichlet forms restricted to the function space whose members take constant values on these collapsing parts. They include as a special case Brownian motion with darning, which has been studied in details in many literatures. When the initial processes have discontinuous sample paths, the processes constructed in this paper are the genuine extensions of those studied in Chen and Fukushima's work. We further show that, up to a time change, these Markov processes with darning can be approximated in the finite dimensional sense by introducing additional large intensity jumps among these compact sets to be collapsed into singletons to the original Markov processes. For diffusion processes, it is also possible to get, up to a time change, diffusions with darning by increasing the conductance on these compact sets to infinity. To accomplish these, we give a version of the semigroup characterization of Mosco convergence to closed symmetric

forms whose domain of definition may not be dense in the L^2-space. The latter is of independent interest and potentially useful to study convergence of Markov processes having different state spaces. Indeed, we show in Section 5 of this paper that Brownian motion in a plane with a very thin flag pole can be approximated by Brownian motion in the plane with a vertical cylinder whose horizontal motion on the cylinder is a circular Brownian motion moving at fast speed. This talk is based on a joint work on with Zhen-Qing Chen.

SECOND-ORDER NECESSARY CONDITIONS FOR STOCHASTIC OPTIMAL CONTROL PROBLEMS

Xu ZHANG *Sichuan University, China*, E-mail: zhang_xu@scu.edu.cn

Abstract: The main purpose of this talk is to present some of our recent results about the second order necessary conditions for stochastic optimal controls with the control variable entering into both the drift and the diffusion terms. In particular, when the control region is convex, a pointwise second-order necessary condition for stochastic singular optimal controls in the classical sense is established, whereas when the control region is allowed to be nonconvex, we obtain a pointwise second-order necessary condition for stochastic singular optimal controls in the sense of the Pontryagin-type maximum principle. Unlike deterministic optimal control problems or stochastic optimal control problems with control-independent diffusions, there exist some essential difficulties in deriving the pointwise second-order necessary optimality conditions from the integral conditions when the controls act in the diffusion terms of the stochastic control systems. Some techniques from Malliavin calculus are employed to overcome these difficulties. Moreover, it is found that, in contrast to the first-order necessary conditions, the correction part of the solution to the second-order adjoint equation appears in the pointwise second-order necessary conditions whenever the diffusion term depends on the control variable, even if the control region is convex. (Jointly with Haisen Zhang)

CRITICAL TWO-POINT FUNCTION FOR LONG-RANGE SELF-AVOIDING WALKS WITH POWER-LAW COUPLINGS

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Abstract: Consider the long-range self-avoiding walks on Z^d, whose one step distribution $D(x)$ decays as $|x|^{-d-\alpha}$ for some $\alpha > 0$. In our previous work (2015), we have shown that, for $\alpha \neq 2$, the critical two-point function $G_{p_c}(x)$ decays as $|x|^{\alpha\wedge 2-d}$ above the upper-critical dimension $d_c := 2(\alpha \wedge 2)$. In this talk, we show that $G_{p_c}(x)$ for $\alpha = 2$ decays as $|x|^{2-d}/\log|x|$ whenever $d \geq d_c$ (including equality). This solves the conjecture in (2015), extend all the way down to $d = d_c$, and confirms a part of predictions in physics (2014). The proof relies on the lace expansion and new convolution bounds on power functions with log corrections.

A WEAK CONVERGENCE APPROACH TO INVENTORY CONTROL USING A LONG-TERM AVERAGE CRITERION

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Abstract: This work considers an optimal inventory control problem using a long-term average criterion. In absence of ordering, the inventory process is modeled by a one-dimensional diffusion on some interval of $(-\infty, \infty)$ with general drift and diffusion coefficients and boundary points that are consistent with the notion that demands tend to reduce the inventory level. Orders instantaneously increase the inventory level and incur both positive fixed and level dependent costs. In addition, state-dependent holding/backorder costs are incurred continuously. Examination of the steady state behavior of (s, S) policies leads to a two-dimensional nonlinear optimization problem for which a pair of optimizers establishes the levels for an optimal (s_*, S^*) policy. Using average expected occupation and ordering measures and weak convergence arguments, weak conditions are given for the optimality of the (s_*, S^*) ordering policy in the general class of admissible policies. The analysis involves an auxiliary C^2 function that solves a particular system of linear equations and inequalities related to but different from the long-term average Hamilton-Jacobi-Bellman equation. This approach provides an analytical solution to the problem rather than a solution involving intricate analysis of the stochastic processes. The utility of these results is illustrated on drifted and geometric Brownian motion inventory models under conventional and non-conventional cost structures.

ENTRANCE AND EXIT AT INFINITY FOR STABLE JUMP DIFFUSIONS

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Abstract: In his seminal work from the 1950s, William Feller classified all one-dimensional diffusions on $-\infty \leq a < b \leq \infty$ in terms of their ability to access the boundary (Feller's test for explosions) and to enter the interior from the boundary. Feller's technique is restricted to diffusion processes as the corresponding differential generators allow explicit computations and the use of Hille-Yosida theory. In the present article we study exit and entrance from infinity for the most natural generalization, that is, jump diffusions of the form

$$dZ_t = \sigma(Z_{t-})dX_t,$$

driven by stable Lévy processes for $\alpha \in (0, 2)$. Many results have been proved for jump diffusions, employing a variety of techniques developed after Feller's work but exit and entrance from infinite boundaries has long remained open. We show that the presence of jumps implies features not seen in the diffusive setting without drift. Finite time explosion is possible for ??(0,1), whereas entrance from different kinds of infinity is possible for $\alpha \in [1, 2)$. We derive necessary and sufficient conditions on ? so that (i) non-exploding solutions exist and (ii) the corresponding transition semigroup extends to an entrance point at 'infinity'. Our proofs are based on very recent developments for path transformations of stable processes via the Lamperti-Kiu representation and new Wiener-Hopf factorisations for Lévy processes that lie therein. The arguments draw together original and intricate applications of results using the Riesz-Bogdan–Żak transformation, entrance laws for self-similar Markov processes, perpetual integrals of Lévy processes and fluctuation theory, which have not been used before in the SDE setting, thereby allowing us to employ classical theory such as Hunt-Nagasawa duality and Getoor's characterisation of transience and recurrence. (Joint work with Leif Döring.)

NEW VERSIONS OF SOME CLASSICAL STOCHASTIC INEQUALITIES

Deli LI *Lakehead University, Canada*, E-mail: dli@lakeheadu.ca

Abstract: Motivated by an investigation of finding necessary and suffcient conditions for the Kolmogorov strong law of large numbers for the general Gini's mean difference, new versions of the classical Lévy, Ottaviani, and Hoffmann- JØrgensen inequalities are obtained for a sequence of Banach space valued random variables. No geometric conditions are imposed on the Banach space. An application to the general Gini's mean difference in a Banach space setting is presented.

EXISTENCE AND PATHWISE UNIQUENESS TO AN SPDE DRIVEN BY COLORED α-STABLE NOISES

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KEY WORDS: Stochastic partial differential equation, colored noise, stable, existence, pathwise uniqueness.

MATHEMATICAL SUBJECT CLASSIFICATION: Primary 60H15; secondary 60K37, 60F05.

Abstract: In this paper we establish the pathwise uniqueness to a stochastic partial differential equation with Hölder continuous coefficient driven by a colored α-stable noise. We also study a stochastic differential equation system driven by Poisson random measures.

PARABOLIC ANDERSON MODEL WITH A FRACTIONAL GAUSSIAN NOISE THAT IS ROUGH IN TIME

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Abstract: This paper concerns the parabolic Anderson equation

$$\frac{\partial u}{\partial t} = \frac{1}{2}\Delta u + u\frac{\partial^{d+1} W^{\mathbf{H}}}{\partial t \partial x_1 \cdots \partial x_d}$$

generated by a $(d+1)$-dimensional fractional noise with the Hurst parameter $\mathbf{H} = (H_0, H_1, \cdots, H_d)$ with special interest in the setting that some of $H_0, \cdots, H_d$ are less than half. In a speaker's recent work, the case of the spatial roughness has been investigated. To put the last piece of the puzzle in place, this work investigates the case when $H_0 < 1/2$ with the concern on solvability, Feynman-Kac's moment formula and intermittency of the system.

ASYMPTOTIC BEHAVIOUR OF EXTINCTION PROBABILITY OF INTERACTING BRANCHING COLLISION PROCESSES

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KEY WORDS: Markov branching processes; Collision branching processes; Interaction branching

Abstract: We consider the uniqueness and extinction properties of the Interacting Branching Collision Process (IBCP), which consists of two strongly interacting components: an ordinary

Markov branching process (MBP) and a collision branching process (CBP). We establish that there is a unique IBCP, and derive necessary and sufficient conditions for it to be non-explosive that are easily to be checked. Explicit expressions are obtained for the extinction probabilities for both regular and irregular cases. The associated expected hitting times are also considered. Examples are provided to illustrate our results.

SINGULAR PERTURBATION ANALYSIS FOR MARKOV MODULATED FLUID MODELS

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Abstract: A Markov modulated fluid queue (X_t, φ_t) is a continuous-time two-dimensional Markov processes, in which X_t, called the level, takes values continuously in R_+, and φ_t, called the phase, is a continuous-time Markov chain with generator T on a finite state space. We consider a Markov modulated fluid queue for which the environment is nearly-completely decomposable, i.e. T is nearly-completely decomposable and can be decomposed as $T = T^* + \varepsilon G$, where T^* is decomposed into several subclasses. Under the basic assumption that both the nearly-completely decomposable Markov modulated fluid model and the aggregated fluid models are positive recurrent, we show that the stationary density of the level can be expanded as convergent power series of the aggregated stationary densities. We go further in the analysis by assuming that one or more of the aggregated fluid queues is not necessarily positive recurrent. We show that the story is significantly different by providing numerical illustration. This talk is based on the joint work with Dendievel Sarah, Latouche Guy and Tang Yingchun.

ON THE ASYMPTOTIC BEHAVIOUR OF THE NUMBER OF RENEWALS VIA TRANSLATED POISSON

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Abstract: One of the popular topics in an introductory course of stochastic processes is the renewal theory and it often ends with the central limit theorem for the number of renewals. However, there are few results in the speed of the convergence. In this talk, we'll answer this question through a translated Poisson approximation with errors of approximation measured in three metrics: the Wasserstein distance, the total variation distance and the Kolmogorov distance. The main tools used are Stein's method and coupling.

ONE-POINT FUNCTION ESTIMATES FOR LOOP-ERASED RANDOM WALK IN THREE DIMENSIONS

Xinyi LI *The University of Chicago, USA*, E-mail: xinyili@uchicago.edu

Abstract: In this talk, we consider loop-erased random walk (LERW) in three dimensions and give an asymptotic estimate on the one-point function for LERW and the non-intersection probability of LERW and simple random walk in three dimensions for dyadic scales. These estimates will be crucial to the characterization of the convergence of LERW to its scaling limit in natural parametrization. This is a joint work with Daisuke Shiraishi (Kyoto).

HARMONIC MOMENTS, LARGE AND MODERATE DEVIATION PRINCIPLES FOR MANDELBROT'S CASCADE IN A RANDOM ENVIRONMENT

Yingqiu LI *Changsha University of science and Technology, China*, E-mail: liyq-2001@163.com

Abstract: For Mandelbrot's cascade in a random environment, we find the critical value for the existence of harmonic moments of the limit variable of Mandelbrot's martingale, and establish large and moderate deviation principles for the free energy. As applications, we show the corresponding limit theorems for branching random walks in random environments.

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