The 13th Workshop on Markov Processes and Related Topics

July 17-21, 2017

Wuhan University

Organizers: Mu-Fa Chen(BNU), Xicheng Zhang(WHU)

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	July 17	**July 18**	**July 19**	**July 20**	**July 21**
08:15-08:30	Opening				
Chairman	**M.-F. Chen**	**C.-R. Hwang**	**M. Röckner**	**Z. Dong**	**Y.Z. Hu**
08:30-09:00	M. Röckner	G. Yin	T. Kumagai	Z. Vondraček	R.M. Song
09:00-09:30	S. Feng	Y. Jiao	J.M. Wang	F.B. Xi	J.P. Li
09:30-10:00	C.-S. Deng	C.H. Ma	G.L. Rang	M.Z. Liu	Y.Y. Liu
10:00-10:30	Tea break	Take picture	Tea break	Tea break	Tea break
Chairman	**Y.Q. Zhao**	**F.Q. Gao**	**Z.-Q. Chen**	**T.F. Jiang**	**R.M. Song**
10:30-11:00	Q.-M. Shao	Z.-Q. Chen	E. Hsu	X.P. Guo	Y.Z. Hu
11:00-11:30	M.-R. Chen	Y.Y. Hu	Z. Dong	X.D. Li	A.H. Xia
11:30-12:00	J.-I. Hong	C. Zhu	Y.Q. Wang	L.H. Xu	
	Lunch	Lunch	Lunch	Lunch	Lunch
Chairman	**Y.C. Xie**	**T. Kumagai**	Free Afternoon	**Z. Vondraček**	
14:30-15:00	Y.Q. Zhao	Y.-X. Ren		T.F. Jiang	
15:00-15:30	Z.-C. Hu	G.Y. Chen		R. Wang	
15:30-16:00	B.-R. Qi	L.J. Xie		H.Q. Li	
16:00-16:30	Tea break	Tea break		Tea break	
Chairman	**Q.-M. Shao**	**F.Y. Wang**		**Y.J. Wang**	
16:30-17:00	K.N. Lu	Q.S. Liu		P. Kim	
17:00-17:30	H. Ge	C.G. Yuan		L.C. Chen	
17:30-18:00	Y.C. Qi	X.X. Chen		X. Chen	

July 17

Chairman: Mu-Fa Chen

08:30-09:00 Michael Röchner (University of Bielefeld, Germany)

Absolutely continuous solutions for continuity equations in Hilbert spaces

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

Diversity indexes

09:30-10:00 Chang-Song Deng (Wuhan University, Wuhan)

Explicit convergence rates for sub-geometric ergodic Markov processes under subordination

10:00-10:30 Tea break

Chairman: Yiqiang Q. Zhao

10:30-11:00 Qi-Man Shao (The Chinese University of Hong Kong, Hong Kong)

Recent progress on self-normalized Cramer type moderate deviations

11:00-11:30 May-Ru Chen (National Sun Yat-sen University, Kaohsiung)

On a time-dependent Eggenberger-Pólya urn model

11:30-12:00 Jyy-I Hong (National Sun Yat-sen University, Kaohsiung)

The coalescence problem in branching processes and its applications

Chairman: Yingchao Xie

14:30-15:00 Yiqiang Q. Zhao (Carleton University, Canada)

A mean field model for a join-the-shortest-queue network

15:00-15:30 Ze-Chun Hu (Sichuan University, Chengdu)

Hunt's hypothesis (H) for the sum of two independent Lévy processes

15:30-16:00 Bo-Rui Qi (Beijing Normal university, Beijing)

Quasi-stationary distributions for one-dimensional minimal diffusion processes

16:00-16:30 Tea break

Chairman: Qi-Man Shao

16:30-17:00 Kening Lu (Brigham Young University, USA)

SRB measures for infinite dimensional dynamical systems

17:00-17:30 Hao Ge (Peking University, Beijing)

Stochastic theory of nonequilibrium thermodynamics

17:30-18:00 Yongcheng Qi(University of Minnesota Duluth, USA)

Spectral radii of truncated circular unitary matrices

July 18

Chairman: Chii-Ruey Hwang

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

Switching diffusions with past-dependent and countable switching

09:00-09:30 Ying Jiao (University of Lyon 1, France)

Dynamics of multivariate default system in random environment

09:30-10:00 Chunhua Ma (Nankai University, Tianjin)

Continuous-state branching processes, extremal processes and super-individuals

10:00-10:30 Tea break

Chairman: Fuqing Gao

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

Time fractional equations and probabilistic representation

11:00-11:30 Yueyun Hu (University of Paris 13, France)

Points of infinite multiplicity of a planar Brownian motion

11:30-12:00 Chao Zhu (University of Wisconsin-Milwaukee, USA)

Jump type stochastic differential equations with non-Lipschitz coefficients and Feller and strong Feller properties

Chairman: Takashi Kumagai

14:30-15:00 Yan-Xia Ren (Peking University, Beijing)

Spine decomposition and $L \log L$ criterion for superprocesses with non-local branching mechanism

15:00-15:30 Guan-Yu Chen (National Chiao Tung University, Hsinchu)

Cutoffs for 1-dim variable speed random walks

15:30-16:00 Longjie Xie (Jiangsu Normal University, Xuzhou)

Ergodicity of stochastic differential equations with jumps and singular coefficients

16:00-16:30 Tea break

Chairman: Feng-Yu Wang

16:30-17:00 Quansheng Liu (Universit Bretagne-Sud, France; Changsha University of Science and Technology)

Harmonic moments and lower large deviations for a supercritical branching process in a random environment

17:00-17:30 Chenggui Yuan (Swansea University, UK)

Invariant measures for stochastic functional differential equations with Markovian switching

17:30-18:00 Xinxin Chen (Université Lyon 1, France)

Long Brownian bridges in hyperbolic spaces converge to Brownian trees

July 19

Chairman: Michael Röckner

08:30-09:00 Takashi Kumagai (RIMS, Kyoto University, Japan)

Heat kernel estimates for time fractional equations

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

Heat kernel estimates and boundary Harnack principle for truncated fractional Laplacian with gradient operator

09:30-10:00 Guanglin Rang (Wuhan University, Wuhan)

Directed polymer in random environment with spatial correlation

10:00-10:30 Tea break

Chairman: Zhen-Qing Chen

10:30-11:00 Elton Hsu (Northwestern University, USA; University of Science and Technology of China, Hefei)

Local differential geometry and Lévy's occupation time arcsine law

11:00-11:30 Zhao Dong (AMSS, CAS, Beijing)

Limiting behavior of stationary measures for stochastic evolution systems

11:30-12:00 Yanqing Wang (Zhongnan University of Economics and Law, Wuhan)

Limit theorems for a supercritical branching process with immigration in a random environment

July 20

Chairman: Zhao Dong

08:30-09:00 Zoran Vondraček (University of Zagreb, Croatia)

On purely discontinuous additive functionals of subordinate Brownian motion

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

Asymptotic properties of regime-switching stochastic damping Hamiltonian systems

09:30-10:00 Minzhi Liu (Beijing Normal University, Beijing)

Limit theorems for supercritical MBPRE with linear fractional offspring distributions

10:00-10:30 Tea break

Chairman: Tiefeng Jiang

10:30-11:00 Xianping Guo (Sun Yat-Sen University, Guangzhou)

A probability criterion for zero-sum stochastic games

11:00-11:30 Xiangdong Li (AMSS, CAS, Beijing)

Harnack inequalities and W-entropy on Riemannian manifolds with super Ricci flows

11:30-12:00 Lihu Xu (University of Macau, Macau)

Convergence rate of stable law: Stein's method approach

Chairman: Zoran Vondraček

14:30-15:00 Tiefeng Jiang (University of Minnesota, USA)

Distances between random orthogonal matrices and independent normals

15:00-15:30 Ran Wang (Wuhan University, Wuhan)

Large deviation principle of occupation measures for monotone SPDEs

15:30-16:00 Huaiqian Li (Sichuan University, Chengdu)

Sharp vertical Littlewood–Paley inequalities for heat flows in weighted L^2 spaces

16:00-16:30 Tea break

Chairman: Yongjin Wang

16:30-17:00 Panki Kim (Seoul National University, South Korea)

Ultracontractivity of symmetric jump processes on unbounded domains

17:00-17:30 Lung-Chi Chen (National Chengchi University, Taipei)

Asymptotic behavior for a long-range Domany-Kinzel model

17:30-18:00 Xin Chen (Shanghai Jiao Tong University, Shanghai)

Dirichlet heat kernel estimates on a horn-shaped domain

July 21

Chairman: Yaozhong Hu

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

Limit theorems for some supercritical superprocesses

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

The $M^X/M/c$ queue with catastrophes and state-dependent control at idle time

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

Bounds on the augmented truncation approximations of invariant measures for Markov chains

10:00-10:30 Tea break

Chairman: Renming Song

10:30-11:00 Yaozhong Hu (University of Kansas, USA)

Itô stochastic differential equations driven by fractional Brownian motions of Hurst parameter $H > 1/2$

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

Normal approximation for statistics of Gibbsian input in geometric probability

CUTOFFS FOR 1-DIM VARIABLE SPEED RANDOM WALKS

Guan-Yu CHEN *Chiao Tung University, Taiwan*, E-mail: gychen@math.nctu.edu.tw

Abstract: In statistical physics, the Bouchaud trap model (BTM, for short) is one useful mechanics in describing the dynamics of spin-glasses, of which scaling limit is widely studied with brilliant conclusions. In this talk, we consider a variant of one-dimensional BTM and discuss its cutoff. This work is joint with Takashi Kumagai.

ASYMPTOTIC BEHAVIOR FOR A LONG-RANGE DOMANY-KINZEL MODEL

Lung-Chi CHEN *Department of Mathematical Sciences, National Chengchi University, Taiwan*, E-mail: lcchen@nccu.edu.tw

Abstract: We consider a long-range Domany-Kinzel model. In this model, for every site (i,j) in a two-dimensional lattice there is a directed bond present from site (i,j) to $(i+1,j)$ with probability one. There are also $m+1$ directed bonds present from (i,j) to $(i-k,j+1)$, $k=-1,0,...,m-1$ with respective probabilities p_{k+1} where m is any positive integer. Given any $m>0$, Let $\tau_m(M,N)$ be the probability that there is at least one connected-directed path of occupied edges from $(0,0)$ to (M,N). In this talk I present that for each aspect ratio $\alpha=M/N$, there is an $\alpha_{m,c}=\frac{\sum_{k=1}^{m} q_k q_{k+1}^2 \cdots q_m^{m-k+1}-(m-1)}{1-q_0 q_1 \cdots q_m}$ such that as $N\to\infty$, $\tau(M,N)$ is 1, 0 and 1/2 for $\alpha>\alpha_c$, $\alpha<\alpha_c$ and $\alpha=\alpha_c$, respectively. I also present the rate of convergence of $\tau_m(M,N)$ and the asymptotic behavior of $\tau_m(M_N^-,N)$ and $\tau_m(M_N^+,N)$ where $M_N^-/N\uparrow\alpha_c$ and $M_N^+/N\downarrow\alpha_c$ as $N\uparrow\infty$. In particular, let $m\to\infty$ and $p_n=p/(n+a)^s$ for some $a,p>0$ and $n\geq 0$. Let $\tau(M,N)=\lim_{m\to\infty}\tau_m(N,M)$. I also discuss the rate of convergence of $\tau(M,N)$ and the asymptotic behavior of $\tau(M_N^-,N)$ and $\tau(M_N^+,N)$ depending on $s>0$ where $M_N^-/N\uparrow\alpha_c$ and $M_N^+/N\downarrow\alpha_c$ as $N\uparrow\infty$. This is a joint work with Shu-Chiuan Chang.

ON A TIME-DEPENDENT EGGENBERGER-PÓLYA URN MODEL

May-Ru CHEN *National Sun Yat-sen University, Taiwan*, E-mail: chenmr@mail.math.nsysu.edu.tw

Abstract: The Eggenberger-Pólya urn model had been studied for a long time and there are several generalizations and applications in the literature. In this talk, we first review some generalized Eggenberger-Pólya urn models. Then we introduce a generalized Pólya-Eggenberger urn model proposed by Pemantle (1990). In his model, assume that the colors of balls in the urn are white and red and that the balls are added into urns are time dependent. We extend Pemantle's model and then discuss the limiting behavior of the sequence of the proportions of the white balls.

DIRICHLET HEAT KERNEL ESTIMATES ON A HORN-SHAPED DOMAIN

Xin CHEN *Shanghai Jiao Tong University, China*, E-mail: chenxin217@sjtu.edu.cn

Abstract: We will give a two-sided estimate for Dirichlet heat kernel on a horn-shaped domain, which usually does not have a uniform $C^{1,1}$ characteristics. This talk is based on a joint work with Panki Kim and Jian Wang.

LONG BROWNIAN BRIDGES IN HYPERBOLIC SPACES CONVERGE TO BROWNIAN TREES

X. CHEN *Institut Camille Jordan, Université Lyon 1, France*,
E-mail: xchen@math.univ-lyon1.fr
G. Miermont *ENS Lyon, France*

Abstract: We consider the long Brownian bridge started from the origin in hyperbolic space H^d and show that its range, after being suitably renormalised, converges in law to a Brownian continuum tree in the sense of Gromov-Hausdorff. The rough idea of the proof will be talked about, by presenting the convergence, obtained by Bougerol and Jeulin [1], of the radial part; the invariance property of re-rooting and the hyperbolicity property. The similar idea will be applied to obtain the local convergence of the infinite Brownian loop in hyperbolic space.

References

[1] Bougerol, P. and Jeulin, T. (1999) Brownian bridge on hyperbolic spaces and on homogeneous trees. *Probab. Theory Related Fields.* **115(1)**, 95-120.

[2] Chen, X. and Miermont, G. (2016) Long Brownian bridges in hyperbolic spaces converge to Brownian trees. `arXiv:1609.01907`

TIME FRACTIONAL EQUATIONS AND PROBABILISTIC REPRESENTATION

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

Abstract: Time-fractional diffusion equation can be used to model the anomalous diffusions exhibiting subdiffusive behavior, due to particle sticking and trapping phenomena. In this talk, I will discuss general fractional-time derivatives and probabilistic representation of solutions of the corresponding parabolic equations in terms of the corresponding inverse subordinators with or without drifts. An explicit relation between occupation measure for Markov processes time-changed by inverse subordinator in open sets and that of the original Markov process in the open set will also be given.

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

Chang-Song DENG *School of Mathematics and Statistics, Wuhan University, China*,
E-mail: dengcs@whu.edu.cn

KEY WORDS: rate of convergence, subordination, Bernstein function, moment estimate.

MATHEMATICAL SUBJECT CLASSIFICATION: 60J25, 60J05

Abstract: We are concerned with three types of convergence rates (sub-exponential, polynomial and logarithmic) of a subordinate Markov process to its invariant measure. It turns out that the classical continuous time subordination in the sense of Bochner can dramatically change the speed of convergence to equilibrium. Analogous results will also be presented for discrete time Markov chains under discrete time subordination in the sense of Bendikov and Saloff-Coste (Math. Nachr., 2012).

LIMITING BEHAVIOR OF STATIONARY MEASURES FOR STOCHASTIC EVOLUTION SYSTEMS

Zhao DONG *Academy of Mathematics and Systems Science, CAS, China*,
E-mail: dzhao@amt.ac.cn

Abstract: The limiting behavior of stochastic evolution processes with small noise intensity ϵ is investigated in distribution-based approach . Let μ^ϵ be stationary measure for stochastic process X^ϵ with small ϵ and X^0 be a semiflow on a Polish space. Assume that $\{\mu^\epsilon : 0 < \epsilon < \epsilon_0\}$ is tight. Then all their weak $*$-limits are X^0-invariant and their supports are contained in Birkhoff center of X^0. Applications are made to various stochastic evolution systems, including stochastic partial differential equations, stochastic functional differential equations, stochastic ordinary differential equations driven by Brownian motion or Lévy process, as well as stochastic approximation with constant step.

DIVERSITY INDEXES

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

Abstract: The diversity index of a population is a number that measures the number of types of individuals and how evenly distributed these individuals are among these types. It is a function of the discrete distribution of various types in the population. This talk surveys several diversity indexes in communication, economics, ecology, and population genetics. When the discrete distribution is random, the index becomes a random variable that serves as statistical estimators for various quantities. Asymptotic results will be presented for a particular diversity index, the homozygosity.

STOCHASTIC THEORY OF NONEQUILIBRIUM THERMODYNAMICS

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

Abstract: Nonequilibrium thermodynamics and statistical physics in terms of stochastic models entered a stage of vigorous development since 1970s, which well fit the development of advanced experimental techniques in modern physical chemistry and biochemistry. I will discuss our recent stochastic approaches to investigate the nonequilibrium thermodynamics. We show that the entropy production rate can be decomposed into the housekeeping heat and the decreasing rate of relative entropy, both of which are nonnegative, followed by a more stronger version of Clausius inequality. We further proved that in the macroscopic limit by merely allowing the molecular numbers to infinite, a generalized macroscopic free energy and its balance equation emerge in chemical reaction systems. The balance equation is valid generally in isothermal driven systems. A general fluctuation dissipation theorem for stochastic reaction kinetics is also proved. Such an emergent "law" is independent of underlying kinetic details. The mathematical theory illustrates how a novel macroscopic dynamic law can emerge from the mesoscopic kinetics in a multi-scale system.

A PROBABILITY CRITERION FOR ZERO-SUM STOCHASTIC GAMES

Xianping GUO *Sun Yat-Sen University, China*, E-mail: mcsgxp@mail.sysu.edu.cn
Xiangxiang Huang *Dongguan University of Technology, China*
Jianping Peng *Sun Yat-Sen Business School, China*

Key words: Zero-sum game, discrete-time Markov chain, probability criterion, first passage time, a pair of optimal policies.

Mathematical Subject Classification: 90C40, 93E20

Abstract: In this paper we introduce a probability criterion for two-person zero-sum stochastic games, and focus on the probability that the payoff before the first passage time to some target state set exceeds a level formulated by both players, which shows the security for player 1, and the risk for player 2. For the game model based on discrete-time Markov chains, under a suitable condition on the game's primitive data, we establish the Shapley equation, from which the existence of the value of the game and a pair of optimal policies with the maximum security for player 1 and the minimum risk for player 2 is ensured. We also provide a recursive way of computing (or at least approximating) the value of the game. At last, the application of our main result is exhibited via an inventory system.

THE COALESCENCE PROBLEM IN BRANCHING PROCESSES AND ITS APPLICATIONS

Jyy-I HONG *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: A branching process is a Markov process which has been commonly used to describe the evolution of a population in various research fields such as genealogy, physics, ecology, epidemiology, finance, etc. One way to investigate the population is to look forward to its future. But, when a population grows so old, it is always interesting to know what happened to it in the past. The coalescence problem provides a way to understand the structure of the population and the ancestry of the individuals in it.

Here, we will consider branching processes with different settings and, in each process, We pick two individuals from those who are alive at the current time by simple random sampling without replacement and trace their lines of descent backward in time till they meet for the first time. We call the common ancestor of these chosen individuals at the coalescent time their *most recent common ancestor*. The coalescence problem is to investigate the limit behaviors of some characteristics of this most recent common ancestor such as its death time and its generation number. Moreover, we will also apply the results from the coalescence problem to branching random walks.

References

[1] K.B. Athreya (2012). Coalescence in the recent past in rapidly growing populations, *Stochastic Processes and Their Applications*, **122**, 11, 3757-3766.

[2] K.B. Athreya (2012). Coalescence in critical and subcritical Galton-Watson branching processes, *Journal of Applied Probability*, **49**, 3, 627-638.

[3] K. B. Athreya & J.-I. Hong (2013). An application of the coalescence theory to branching random walks, *Journal of Applied Probability*, **50**, 3, 893-899.

[4] J.-I. Hong (2013). Coalescence in subcritical Bellman-Harris age-dependent branching processes, *Journal of Applied Probability*, **50**, 2, 576-591.

[5] J.-I. Hong (2015). Coalescence on supercritical multi-type branching processes, *Sankhya A*, **77**, 1, 67-78.

[6] J.-I. Hong (2016). Coalescence on critical and subcritical multi-type branching processes, *Journal of Applied Probability*, **53**, 3, 802-817.

[7] K. B. Athreya & J.-I. Hong (?). Coalescence on supercritical Bellman-Harris branching processes, *to appear in Taiwanese Journal of Mathematics.*

LOCAL DIFFERENTIAL GEOMETRY AND LÉVY'S OCCUPATION TIME ARCSINE LAW

Elton HSU *Northwestern University, USA and University of Science and Technology of China*, E-mail: ehsu@math.northwestern.edu

Abstract: We discuss an extension of the classical Lévy's arcsine law for occupation time of Brownian motion to a Riemannian manifold. The two term asymptotic expansion of the occupation time of the local half space is related to the Brownian motion local time and the mean curvature of the embedded hypersurface.

ITÔ STOCHASTIC DIFFERENTIAL EQUATIONS DRIVEN BY FRACTIONAL BROWNIAN MOTIONS OF HURST PARAMETER $H > 1/2$

Yaozhong HU *University of Kansas, USA*, E-mail: yhu@ku.edu

Abstract: This talk will present a result on existence and uniqueness of solution of Itô type stochastic differential equation $dx(t) = b(t, x(t))dt + \sigma(t, x(t))dB(t)$, where $B(t)$ is a fractional Brownian motion of Hurst parameter $H > 1/2$ and $dB(t)$ is the Itô differential defined by using Wick product or divergence operator. The coefficients b and σ are random and anticipative. Using the relationship between the Itô and pathwise integrals we first write the equation as a stochastic differential equation involving pathwise integral plus a Malliavin derivative term. To handle this Malliavin derivative term the equation is then further reduced to a system of characteristic equations without Malliavin derivative, which is then solved by a careful analysis of Picard iteration, with a new technique to replace the Gronwall lemma which is no longer applicable. The solution of this system of characteristic equations is then applied to solve the original Itô stochastic differential equation up to a positive random time. In special linear and quasilinear cases the global solutions are proved to exist uniquely.

POINTS OF INFINITE MULTIPLICITY OF A PLANAR BROWNIAN MOTION

Yueyun HU *University of Paris 13, France*, E-mail: yueyun@math.univ-paris13.fr

Abstract: The talk is based on a joint work with Elie Aïdékon and Zhan Shi.

It is well-known (see Dvoretzky, Erdős and Kakutani (1958) and Le Gall (1987)) that a planar Brownian motion has points of infinite multiplicity, and these points form a dense set on the range. Our main result is the construction of a family of random measures, denoted by $\{\mathcal{M}_\infty^\alpha\}_{0<\alpha<2}$, that are supported by the set of the points of infinite multiplicity. We prove that for each $\alpha \in (0, 2)$, the carrying dimension of $\mathcal{M}_\infty^\alpha$ equals $2 - \alpha$, and $\mathcal{M}_\infty^\alpha$ is supported by the thick points defined in Bass, Burdzy and Koshnevisan (1994) as well as that defined in Dembo, Peres, Rosen and Zeitouni (2001).

HUNT'S HYPOTHESIS (H) FOR THE SUM OF TWO INDEPENDENT LÉVY PROCESSES

Ze-Chun HU *Sichuan University, China*, E-mail: zchu@scu.edu.cn

Abstract: Which Lévy processes satisfy Hunt's hypothesis (H) is a long-standing open problem in probabilistic potential theory. The study of this problem for one-dimensional Lévy processes suggests us to consider (H) from the point of view of the sum of Lévy processes. In this paper, we present theorems and examples on the validity of (H) for the sum of two independent Lévy processes. We also give a novel condition on the Lévy measure which implies (H) for a large class of one-dimensional Lévy processes. This talk is based on a joint paper with Wei Sun.

DISTANCES BETWEEN RANDOM ORTHOGONAL MATRICES AND INDEPENDENT NORMALS

Tiefeng JIANG *University of Minnesota, USA*, E-mail: jiang040@umn.edu

Abstract: We study the distance between Haar-orthogonal matrices and independent normal random variables. The distance is measured by the total variation distance, the Kullback-Leibler distance, the Hellinger distance and the Euclidean distance. They appear different features. Optimal rates are obtained. This is a joint work with Yutao Ma.

DYNAMICS OF MULTIVARIATE DEFAULT SYSTEM IN RANDOM ENVIRONMENT

Ying JIAO *University of Lyon 1, France*, E-mail: ying.jiao@univ-lyon1.fr

Abstract: We consider a multivariate default system where random environmental information is available. We study the dynamics of the system in a general setting of enlargement of filtrations and adopt the point of view of change of probability measures. We also make a link with the density approach in the credit risk modelling. Finally, we present a martingale characterization result with respect to the observable information filtration on the market. This is a joint work with Nicole El Karoui and Monique Jeanblanc.

INTRINSIC ULTRACONTRACTIVITY OF SYMMETRIC JUMP PROCESSES ON UNBOUNDED DOMAINS

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

Abstract: In this talk, we consider a symmetric pure-jump Markov process on Euclidean space generated by a non-local Dirichlet form with jumping kernel $J(x, y)$. We first discuss sufficient conditions for the compactness and the intrinsic ultracontractivity of the Dirichlet Markov semigroup on D when D is an unbounded open set. When D is the horn-shaped domain, we will discuss sharp criterion for the intrinsical ultracontractivity and the sharp estimates of the ground state.

This is a joint work with Xin Chen (Shanghai Jiao Tong University) and Jian Wang (Fujian Normal University).

HEAT KERNEL ESTIMATES FOR TIME FRACTIONAL EQUATIONS

Takashi KUMAGAI *RIMS, Kyoto University, Japan*,
E-mail: kumagai@kurims.kyoto-u.ac.jp
Zhen-Qing Chen *University of Washington, USA*
Panki Kim *Seoul National University, Republic of Korea*
Jian Wang *Fujian Normal University, China*

Abstract: In this talk, we first discuss existence and uniqueness of weak solutions to general time fractional equations and give their probabilistic representation. We then talk about sharp two-sided estimates for fundamental solutions of general time fractional equations in metric measure spaces.

SHARP VERTICAL LITTLEWOOD–PALEY INEQUALITIES FOR HEAT FLOWS IN WEIGHTED L^2 SPACES

Huaiqian LI *Sichuan University, China*, E-mail: hqlee@scu.edu.cn

Abstract: We establish estimates on vertical Littlewood–Paley square functions for heat flows in the weighted L^2 space under the Riemannian curvature-dimension condition $\mathrm{RCD}^*(0,N)$ with $N \in [1,\infty)$, which are sharp on the growth of the 2-heat weight and the 2-Muckenhoupt weight considered. The p-heat weight and the p-Muckenhoupt weight are also compared for all $p \in (1,\infty)$. The results can also be established on a large class of sub-Riemannian manifolds sastisfying the generalized curvature-dimension condition in the sense of Baudoin–Garofalo.

THE $M^X/M/c$ QUEUE WITH CATASTROPHES AND STATE-DEPENDENT CONTROL AT IDLE TIME

Junping LI *Central South University, China*, E-mail: jpli@mail.csu.edu.cn
Lina Zhang *Xiangtan University, China*

Key words: Markovian bulk-arriving queues, equilibrium distribution, recurrence, queue size, effective catastrophe.

Mathematical Subject Classification: Primary 60J27, Secondary 60J35

Abstract: In this paper, we consider an $M^X/M/c$ queue with catastrophes and state-dependent control at idle time. Properties of the queue which terminate at idle are firstly studied. Recurrence and equilibrium properties are studied for the case of resurrection and no catastrophes. All of these results and the first effective catastrophe occurrence time are then investigated for the case of resurrection and catastrophes. In particular, we obtain the Laplace transform of the transition probability for the absorbing $M^X/M/c$ queue.

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HARNACK INEQUALITIES AND W-ENTROPY ON RIEMANNIAN MANIFOLDS WITH SUPER RICCI FLOWS

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Abstract: In this talk, I will present some recent results on the study of the Harnack inequalities and W-entropy on Riemannian manifolds with various curvature-dimension conditions and super Ricci flows. Joint work with Songzi Li.

LIMIT THEOREMS FOR SUPERCRITICAL MBPRE WITH LINEAR FRACTIONAL OFFSPRING DISTRIBUTIONS

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Abstract: We investigate the limit behaviors of supercritical multitype branching processes in random environment with linear fractional offspring distributions. There exists a phase transition in the behaviors of the process affected by strongly and intermediately supercritical regimes. Some conditional limit theorems can also be obtained from the representation of generating functions.

HARMONIC MOMENTS AND LOWER LARGE DEVIATIONS FOR A SUPERCRITICAL BRANCHING PROCESS IN A RANDOM ENVIRONMENT

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Abstract: Let $(Z_n)_{n\geq 0}$ be a supercritical branching process in an independent and identically distributed random environment $\xi = (\xi_n)_{n\geq 0}$. We study the asymptotic behavior of the harmonic moments $\mathbb{E}[Z_n^{-r}|Z_0 = k]$ of order $r > 0$ as $n \to \infty$, when the process starts with k initial individuals. We exhibit a phase transition with the critical value $r_k > 0$ determined by the equation $\mathbb{E}p_1^k(\xi_0) = \mathbb{E}m_0^{-r_k}$, where $m_0 = \sum_{j=0}^{\infty} jp_j(\xi_0)$, $(p_j(\xi_0))_{j\geq 0}$ being the offspring distribution given the environment ξ_0. Contrary to the constant environment case (the Galton-Watson case), this critical value is different from that for the existence of the harmonic moments of $W = \lim_{n\to\infty} Z_n/\mathbb{E}(Z_n|\xi)$. The aforementioned phase transition is linked to that for the rate function of the lower large deviation for Z_n. As an application, we obtain a lower large deviation result for Z_n under weaker conditions than in previous works and give a new expression of the rate function, and improve an earlier result about the convergence rate in the central limit theorem for $W - W_n$.

BOUNDS ON THE AUGMENTED TRUNCATION APPROXIMATIONS OF INVARIANT MEASURES FOR MARKOV CHAINS

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Abstract: In this talk, we report some results about the augmented truncation approximations of invariant measures for Markov chains. Specifically, suppose that P is a positive recurrent infinite transition matrix with invariant distribution π and ${}_{(n)}\tilde{P}$ is a truncated and arbitrarily augmented stochastic matrix with invariant distribution ${}_{(n)}\pi$. We derive computable truncation bounds on ${}_{(n)}\pi - \pi$ with respect to a suitable vector norm from three aspects: the Poisson's equation, residual matrix and ergodicity coefficients. The arguments are mainly based on the technique of perturbation analysis. We give a comparison of these bounds, and we also compare our results with the ones in Tweedie (1998). Moreover, we consider the extension of the results to continuous-time Markov chains.

This is based on the joint work with Li Wendi.

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SRB MEASURES FOR INFINITE DIMENSIONAL DYNAMICAL SYSTEMS

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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.

CONTINUOUS-STATE BRANCHING PROCESSES, EXTREMAL PROCESSES AND SUPER-INDIVIDUALS

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Abstract: The long-term behaviors of flows of continuous-state branching processes are characterized through subordinators and extremal processes. The extremal processes arise in the case of supercritical processes with infinite mean and of subcritical processes with infinite variation. The jumps of these extremal processes are interpreted as specific initial individuals whose progenies overwhelm the population. These individuals, which correspond to the records of a certain Poisson point process embedded in the flow, are called super-individuals. They radically increase the growth rate to $+\infty$ in the supercritical case, and slow down the rate of extinction in the subcritical one. This is a joint work with Clément Foucart.

QUASI-STATIONARY DISTRIBUTIONS FOR ONE-DIMENSIONAL MINIMAL DIFFUSION PROCESSES

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Abstract: We prove that there exits a unique quasi-stationary distribution (QSD) for the minimal diffusion process with 0 entrance boundary and infinity exit/ regular boundary. We also prove the unique QSD attracts all the initial distributions and obtain a spectral representation for the QSD.

SPECTRAL RADII OF TRUNCATED CIRCULAR UNITARY MATRICES

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Abstract: Consider a truncated circular unitary matrix which is a p_n by p_n submatrix of an n by n circular unitary matrix by deleting the last $n - p_n$ columns and rows. Jiang and Qi (2017) proved that the maximum absolute value of the eigenvalues (known as spectral radius) of the truncated matrix, after properly normalized, converges in distribution to the Gumbel distribution if p_n/n is bounded away from 0 and 1. We investigate the limiting distribution of the spectral radius under one of the following four conditions: (1). $p_n \to \infty$ and $p_n/n \to 0$ as $n \to \infty$; (2). $(n - p_n)/n \to 0$ and $(n - p_n)/(\log n)^3 \to \infty$ as $n \to \infty$; (3). $n - p_n \to \infty$ and $(n - p_n)/\log n \to 0$ as $n \to \infty$ and (4). $n - p_n = k \geq 1$ is a fixed integer. We prove that the spectral radius converges in distribution to the Gumbel distribution under the first three conditions and to a reversed Weibull distribution under the fourth condition.

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DIRECTED POLYMER IN RANDOM ENVIRONMENT WITH SPATIAL CORRELATION

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Abstract: We consider the limit behavior of partition function of directed polymers in random environment represented by linear model instead of a family of i.i.d. variables in 1+1 dimensions. Under the assumption that the correlation decays algebraically, using the method developed in [Ann. Probab., 42(3): 1212-1256, 2014], under a new scaling we show the scaled partition function as a process defined on $[0,1]\times\mathbf{R}$, converges weakly to the solution to some stochastic heat equations driven by fractional Brownian field. The Hurst parameter is determined by the correlation exponent of the random environment. Here multiple Itô integral with respect to fractional Gaussian field and spectral representation of stationary process are heavily involved.

SPINE DECOMPOSITION AND $L\log L$ CRITERION FOR SUPERPROCESSES WITH NON-LOCAL BRANCHING MECHANISM

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Abstract: In this talk, I will describe a pathwise spine decomposition for superprocesses with both local and non-local branching mechanisms under a martingale change of measure. This result complements the related results obtained in Evans (1993), Kyprianou et al. (2012) and Liu, Ren and Song (2009) for superprocesses with purely local branching mechanisms and in Chen, Ren and Song (2016) and Kyprianou and Palau (2016) for multitype superprocesses. As an application of this decomposition, we obtain necessary/sufficient conditions for the limit of the fundamental martingale to be non-degenerate. In particular, we obtain extinction properties of superprocesses with non-local branching mechanisms as well as a Kesten-Stigum *LlogL* theorem for the fundamental martingale.

The talk is based on a joint work with Renming Song and Ting Yang.

ABSOLUTELY CONTINUOUS SOLUTIONS FOR CONTINUITY EQUATIONS IN HILBERT SPACES

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Abstract: This is a joint work with Giuseppe Da Prato.

We prove existence and uniqueness of solutions to continuity equation in a separable Hilbert space. We look for solutions which are absolutely continuous with respect to a reference measure γ which is the invariant measure of a reaction-diffusion equation. We exploit that the gradient operator D_x is closable with respect to $L^p(H;\gamma)$ and a recent formula for the commutator $D_xP_t - P_tD_x$ where P_t is the transition semigroup corresponding to the reaction-diffusion equation, [DaDe14]. We stress that P_t is not necessarily symmetric. Our paper is an extension of [DaFlRo14] where γ was the invariant measure of a suitable Ornstein-Uhlenbeck process.

RECENT PROGRESS ON SELF-NORMALIZED CRAMER TYPE MODERATE DEVIATIONS

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Abstract: The Cramér type moderate deviation quantifies accuracy of the relative error of distributional approximation and can provide a theoretical justification for the use of limiting tail probability. In this talk we shall review recent progress on Cramér type moderate deviation for self-normalized sums of independent random variables, self-normalized martingales and self-normalized quantile estimator.

LIMIT THEOREMS FOR SOME SUPERCRITICAL SUPERPROCESSES

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Abstract: Let $X = \{X_t\}$ be a supercritical superprocesses in a space E. Let $\lambda_0 > 0$ be the first eigenvalue of the mean semigroup of X and let ϕ_0 be a positive eigenfunction corresponding to λ_0. Then $M_t := e^{-\lambda_0 t}\langle \phi_0, X_t\rangle$ is a nonnegative martingale. Let $M_\infty := \lim_{t\to\infty} M_t$. It is known that M_∞ is nondegenerate iff the $L\log L$ condition is satisfied. In this talk I will present some recent result in the case when the $L\log L$ condition is not satisfied. We prove that there is a non-trivial family of backward iterates γ_t and a non-degenerate random variable W such that for any $\mu \in \mathcal{M}_F(E)$,

$$\lim_{t\to\infty} \gamma_t\langle \phi_0, X_t\rangle = W, \qquad \text{a.s.-}\mathbf{P}_\mu.$$

We also give the almost limit of $\gamma_t\langle f, X_t\rangle$ for general test function f.

ON PURELY DISCONTINUOUS ADDITIVE FUNCTIONALS OF SUBORDINATE BROWNIAN MOTION

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Abstract: Let $A_t = \sum_{s\le t} F(X_{s-}, X_s)$ be a purely discontinuous additive functional of a subordinate Brownian motion $X = (X_t, \mathbf{P}_x)$. In this talk I will describe a sufficient condition on the non-negative function F that guarantees that finiteness of A_∞ implies finiteness of its expectation. This result is then applied to study the relative entropy of $\mathbf{P}_x$ and the probability measure induced by a purely discontinuous Girsanov transform of the process X. These results are proved under the weak global scaling condition on the Laplace exponent of the underlying subordinator.

HEAT KERNEL ESTIMATES AND BOUNDARY HARNACK PRINCIPLE FOR TRUNCATED FRACTIONAL LAPLACIAN WITH GRADIENT OPERATOR

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Abstract: We consider the following type of non-local operator with gradient perturbation

$$\mathcal{L}^b := \overline{\Delta}^{\alpha/2} + b(x)\nabla f(x),$$

where $\alpha \in (1,2)$ and $b \in K_d^{\alpha-1}$. The operator $\mathcal{L}^b$ can be viewed as the operator $\Delta^{\alpha/2}+b(x)\nabla f(x)$ with large jumps more than 1 removed. A strong Markov process X^b with transition density function $q^b(t,x,y)$ associated with $\mathcal{L}^b$ is established and the two-sided estimates of $q^b(t,x,y)$ in R^d is given for $t \in (0,1)$. Moreover, when b is a bounded function, the estimates are sharp. Furthermore, we establish the boundary Harnack principle for the process X^b with $b \in K_d^{\alpha-1}$ in Lipschitz open sets under some mild conditions. Especially, when b is a bounded function, the boundary Harnack principle for X^b holds in open sets satisfying some condition.

LIMIT THEOREMS FOR A SUPERCRITICAL BRANCHING PROCESS WITH IMMIGRATION IN A RANDOM ENVIRONMENT

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Abstract: Let (Z_n) be a supercritical branching process with immigration in a random environment. Firstly, we prove that under a simple log moment condition on the offspring and immigration distributions, the naturally normalized population size W_n converges almost surely to a finite random variable W. Secondly, we show criterions for the non-degeneracy and for the existence of moments of the limit random variable W. Finally, we establish a central limit theorem, a large deviation principle and a moderate deviation principle about $\log Z_n$.

ASYMPTOTIC PROPERTIES OF REGIME-SWITCHING STOCHASTIC DAMPING HAMILTONIAN SYSTEMS

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KEY WORDS: Stochastic Hamiltonian system, damping, regime-switching, martingale problem, Radon-Nikodym derivative, strong Feller property, exponential ergodicity.

MATHEMATICAL SUBJECT CLASSIFICATION: 60J60, 60J27, 34D25.

Abstract: This work focuses on a class of stochastic Hamiltonian systems with both damping and continuous-state-dependent switching. First, for a special Markovian switching case, the existence of a globally weak solution is constructed by making using of the martingale approach.

Next, for the general state-dependent switching case, the existence of a globally weak solution is established by virtue of the Radon-Nikodym derivative method. Then, strong Feller property is proved by the killing technique and the Radon-Nikodym derivative method with a truncation argument. Based on these results, exponential ergodicity is obtained under the Foster-Lyapunov drift condition. Finally, some examples are presented for illustration.

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NORMAL APPROXIMATION FOR STATISTICS OF GIBBSIAN INPUT IN GEOMETRIC PROBABILITY

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Abstract: We consider the asymptotic behaviour of a random variable W_λ resulting from the summation of the functionals of a Gibbsian spatial point process over windows $Q_\lambda \to R^d$, where Q_λ is a window with volume λ. We establish conditions ensuring that W_λ has volume order fluctuations, i.e. they coincide with the fluctuations of functionals of Poisson spatial point processes. We combine this result with Stein's method to deduce rates of a normal approximation for W_λ as $\lambda \to \infty$. Our general results establish variance asymptotics and central limit theorems for statistics of random geometric and related Euclidean graphs on Gibbsian input. We also establish a similar limit theory for claim sizes of insurance models with Gibbsian input, the number of maximal points of a Gibbsian sample, and the size of spatial birth-growth models with Gibbsian input. This is a joint work with J. E. Yukich.

ERGODICITY OF STOCHASTIC DIFFERENTIAL EQUATIONS WITH JUMPS AND SINGULAR COEFFICIENTS

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Abstract: We show the strong well-posedness of SDEs driven by general multiplicative Lévy noises with Sobolev diffusion and jump coefficients and integrable drift. Moreover, we also study the strong Feller property, irreducibility as well as the exponential ergodicity of the corresponding semigroup when the coefficients are time-independent and singular dissipative. In particular, the large jump is allowed in the equation. This is a joint work with Xicheng Zhang.

CONVERGENCE RATE OF STABLE LAW: STEIN'S METHOD APPROACH

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Abstract: Stein's method was first put forward by Charles Chen in 1970s to prove Berry-Esseen bound of central limit theorem, and later extended by Louis Chen to study Poisson approximation. In the past 50 years, the convergence rate of stable law was studied from time to time by many probabilists, but all their approaches were from characteristic function.

We shall apply Stein's method to prove a general inequality about stable law of i.i.d. heavy tailed random sequence, from which one can derive a convergence rate $n^{-\frac{2-\alpha}{\alpha}}$ with $\alpha > 1$. This rate seems better than the known results in literatures, we conjecture that the optimal convergence rate of stable law is $n^{-\frac{2-\alpha}{\alpha}}$ rather than $n^{-1/\alpha}$. The main ingredient of our analysis is to study Kolmogorov backward equation of OU stable process and use basic heat kernel estimates of stable processes.

LARGE DEVIATION PRINCIPLE OF OCCUPATION MEATURES FOR MONOTONE SPDES

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Abstract: Using the hyper-exponential recurrence criterion, a large deviation principle for the occupation measure is derived for a class of non-linear monotone stochastic partial differential equations. The main results are applied to many concrete SPDEs such as stochastic p-Laplace equation, stochastic porous medium equation, stochastic fast-diffusion equation, and even stochastic real Ginzburg-Landau equation driven by α-stable noises. Joint work with Jie XIONG and Lihu XU.

SWITCHING DIFFUSIONS WITH PAST-DEPENDENT AND COUNTABLE SWITCHING

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Key words: ergodicity

Mathematical Subject Classification: 60J60, 60H10.

Abstract: In this talk, we study a class of switching diffusions consisting of a continuous component and a discrete component. We consider the case that the switching process takes values in a countable set and the associate operator could be past dependent. We study recurrence, ergodicity, and stability of the system. This is a joint work with Dang Nguyen.

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INVARIANT MEASURES FOR STOCHASTIC FUNCTIONAL DIFFERENTIAL EQUATIONS WITH MARKOVIAN SWITCHING

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Abstract: In this talk, the existence and uniqueness of invariant measures for stochastic functional differential equations with Markovian switching and their time discretizations have been discussed. Under certain ergodic conditions, we show that the these equations enjoy a unique invariant probability measure and converge exponentially to its equilibrium under the Wasserstein distance. Also, we demonstrate that the time discretization of these equations admit a unique invariant probability measure and share the corresponding ergodic property when the stepsize

is sufficiently small. During this procedure, the difficulty arose from the time-discretization of continuous time Markov chain has to be deal with, for which an estimate on its exponential functional is presented.

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A MEAN FIELD MODEL FOR A JOIN-THE-SHORTEST-QUEUE NETWORK

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Abstract: In this talk, we introduce a mean field model to study a queueing network with N queues (nodes), where N is large. In this system, each queue has a dedicated input stream and in addition there is an extra input stream, which balances the load of the network by directing its arriving customers to the shortest queue. In terms of the mean field limit, studies of the performance of this network are presented. One of our results shows that the stationary behavior of any of the queues can be approximated by that of the $M/M/1$ queue with a modified boundary transition rate.

This talk is based on joint work with Don Dawson and Jiashan Tang.

JUMP TYPE STOCHASTIC DIFFERENTIAL EQUATIONS WITH NON-LIPSCHITZ COEFFICIENTS AND FELLER AND STRONG FELLER PROPERTIES

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Abstract: This work is focused on multidimensional jump type stochastic differential equations with super linear growth and non-Lipschitz coefficients. We present sufficient conditions for non-explosion and pathwise uniqueness for such SDEs. The non confluence property for solutions is investigated. Feller and strong Feller properties under non-Lipschitz conditions are investigated via the coupling method. As applications, we also study multidimensional SDEs driven by Lévy processes and present a Feynman-Kac formula for a Cauchy problem associated with a Lévy type operator.

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