The 20th Workshop on Markov Processes and Related Topics

July 6-July 10, 2025

Jiangsu Normal University

Chair: Mu-Fa Chen (BNU & JSNU)

Organization Committee: Dayue Chen, Wenming Hong, Zenghu Li, Yong-Hua Mao, Wei Liu, Jian Wang, Feng-Yu Wang, Xianping Guo, Yingchao Xie, Xicheng Zhang

Local Organizer: Yingchao Xie, Zhengke Miao, Peng Zhao, Wei Liu, Chao Zhang, Yueling Li, Qin Zhou

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Key Laboratory of Mathematics and Complex Systems of Ministry of Education, School of Mathematical Sciences, Beijing Normal University

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Fund for National Key Research and Development Program of China

ZOOM: 【Session 1】Meeting ID: 861 246 57644 Password: 752924

【Session 2】Meeting ID: 821 911 59416 Password: 709523

Research Institute of Mathematical Science, Jiangsu Normal University

Stochastics Research Center, School of Mathematical Sciences,

Beijing Normal University

Secretary: Qinling Fu (Beijing Normal University)

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

Website: http://math0.bnu.edu.cn/probab/Workshop2025/

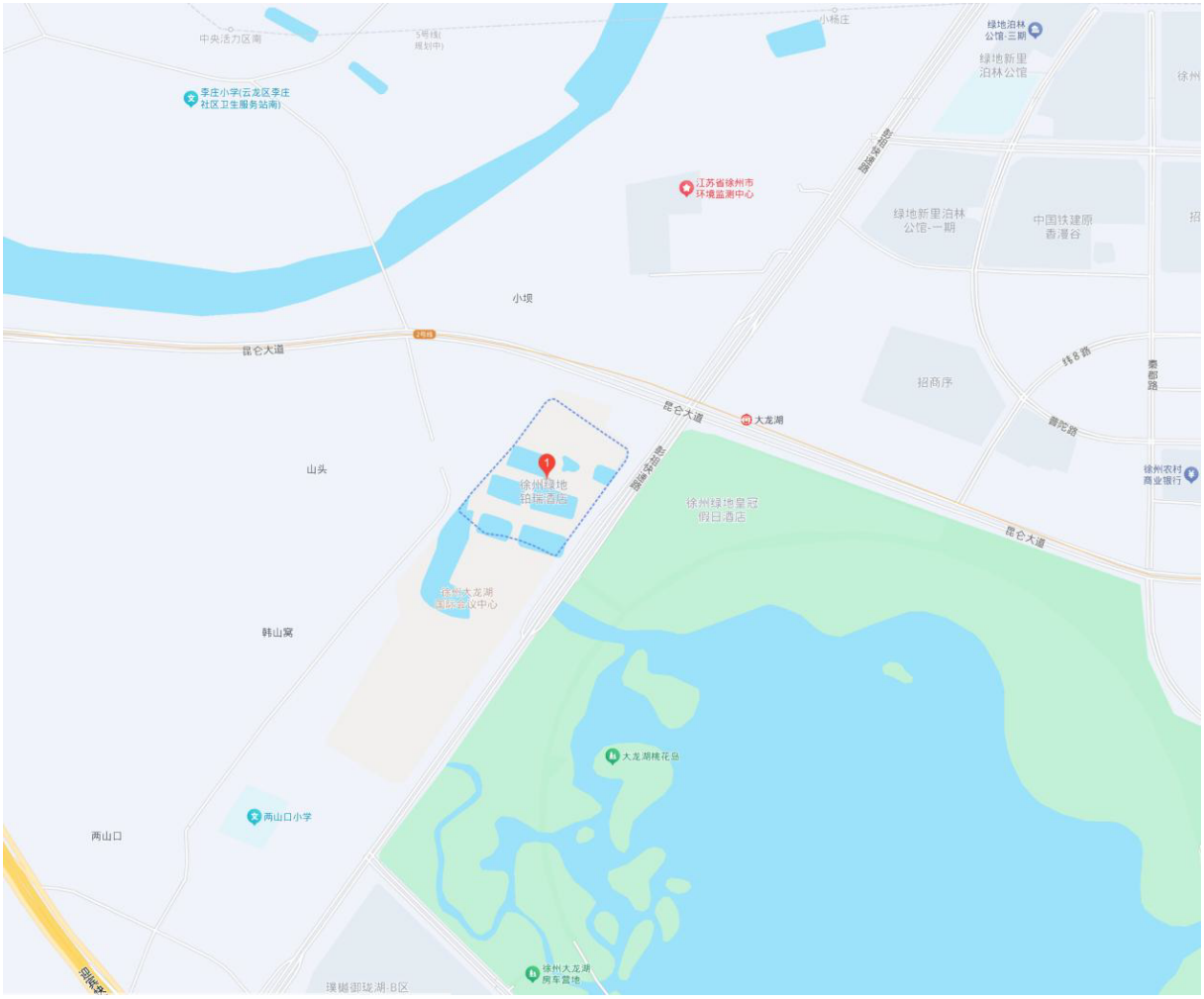
Sign In

14:00-21:00 July 6

Hotel and Registration

- **Xuzhou Greenland Borui Hotel:** No. 59 Pengzu Avenue, Yunlong District, Xuzhou City, Jiangsu Province

  徐州绿地铂瑞酒店：江苏省徐州市云龙区彭祖大道59号



Traffic Suggestions

- **Xuzhou East Railway Station** (徐州东站) ⟶ **Xuzhou Greenland Borui Hotel** (徐州绿地铂瑞酒店)

  1. **Taxi** (出租车): It takes about 20 minutes and costs about ¥20.

  2. **Metro** (地铁): Xuzhou East Railway Station (徐州东站) (line 1) ⟶ Pengcheng Square Station (彭城广场站) (line 2) ⟶ Dalonghu Station (大龙湖站). It takes about 1 hour and 7 minutes.

- **Xuzhou Railway Station** (徐州火车站) ⟶ **Xuzhou Greenland Borui Hotel** (徐州绿地铂瑞酒店)

  1. **Taxi** (出租车): It takes about 20 minutes and costs about ¥30.

  2. **Metro** (地铁): Xuzhou Railway Station (徐州火车站) (line 3) ⟶ Huaihai Memorial Tower Station (淮塔站) (line 2) ⟶ Dalonghu Station (大龙湖站). It takes about 45 minutes.

- **Xuzhou Guanyin International Airport** (徐州观音机场) ⟶ **Xuzhou Greenland Borui Hotel** (徐州绿地铂瑞酒店)

  1. **Taxi** (出租车): It takes about 40 minutes and costs about ¥70.

  2. **Metro** (地铁): Airport Bus Line 1 (机场大巴1号线) ⟶ Xuzhou Central Bus Station (徐州汽车总站), Tianqiao Station (天桥站) (line 3) ⟶ Huaihai Memorial Tower Station (淮塔站) (line 2) ⟶ Dalonghu Station (大龙湖站). It takes about 1 hour and 50 minutes.

Schedule - Session 1

Milti Functional Hall 1 (2nd Floor of the Hotel)

Beijing Time (GMT+8)	**July 7 (Monday)**	**July 8 (Tuesday)**	**July 9 (Wednesday)**	**July 10 (Thursday)**
Chairman	**Yingchao Xie**	**Hui He**	**Xiaowen Zhou**	**Xianping Guo**
08:30-09:00	OPENING	Deli Li	Zenghu Li	Yong-Hua Mao
09:00-09:30	Presentation	Vladimir Vatutin	Yaozhong Hu	Lu-Jing Huang
09:30-10:00		Huaming Wang	Jiayan Guo	Guangqiang Lan
	Break			
Chairman	**Zenghu Li**	**Lihu Xu**	**Feng-Yu Wang**	**Yong-Hua Mao**
10:30-11:00	Kening Lv	Xianping Guo	Shizan Fang	Dejun Luo
11:00-11:30	Zhen-Qing Chen	Wenzhao Zhang	Jiang-Lun Wu	Xinxin Chen
11:30-12:00	Shui Feng	Zhongyang Sun	Panpan Ren	Fei Pu
	Lunch			
Chairman	**Zhen-Qing Chen**	**Zhan Shi**	**Shizhan Fang**	
14:30-15:0	Feng-Yu Wang	Renming Song	Nicolas Privault	
15:00-15:30	Kim Panki	Hui He	Soobin Cho	
15:30-16:00	Kyung-Youn Kim	Tianyi Bai	Huiping Chen	
	Break			
Chairman	**Kening Lv**	**Renming Song**	**Dayue Chen**	
16:30-17:00	Takashi Kumagai	Xiaowen Zhou	Quansheng Liu	
17:00-17:30	Zhan Shi	Yuanyuan Liu	Jieliang Hong	
17:30-18:00	Jie-Ming Wang	Xu Yang	Yue-Shuang Li	
	Dinner			

The meeting place is at the **Zhihua Hall (智华楼), Research Institute of Mathematical Science, Jiangsu Normal University** on the morning of July 7, and in the **Halls of the Hotel** for other time. Dinner on July 7 is served at **Conference Center Platinum Rui Hall 1 (北楼二楼会议中心铂瑞一厅)**, and at **Excellent Western Restaurant (南楼一楼卓越西餐厅)** for all other lunch and dinner.

Schedule - Session 2

Multi Functional Hall 2 (2nd Floor of the Hotel)

Beijing Time (GMT+8)	**July 7 (Monday)**	**July 8 (Tuesday)**	**July 9 (Wednesday)**	**July 10 (Thursday)**
Chairman		**Yan-Xia Ren**	**Wei Liu(JSNU)**	**Xian-Yuan Wu**
08:30-09:00		Fubao Xi	Tusheng Zhang	Xing Wang
09:00-09:30		Yutao Ma	Jianhai Bao	Hao Tang
09:30-10:00		Zhenzhong Zhang	Chang-Song Deng	Chenxu Hao
		Break		
Chairman		**Fubao Xi**	**Tusheng Zhang**	
10:30-11:00		Chenggui Yuan	Xiang-Dong Li	
11:00-11:30		Haifeng Huo	Jinghai Shao	
11:30-12:00		Zhong-Wei Liao	Fan Yang	
	Lunch			
Chairman	**Shui Feng**	**Chenggui Yuan**	**Xiang-Dong Li**	
14:30-15:00	Xia Chen	Xian-Yuan Wu	Zhao Dong	
15:00-15:30	Zechun Hu	Yuqiang Li	Fang Chen	
15:30-16:00	Xinyi Li	Michael Choi	Shuaiqi Zhang	
	Break			
Chairman	**Xia Chen**	**Jian Wang**	**Zhao Dong**	
16:30-17:00	Fuqing Gao	Liming Wu	Wei Liu(WHU)	
17:00-17:30	Huaiqian Li	Bo Wu	Xing Huang	
17:30-18:00	Ziyu Liu	Ling-Di Wang	Bin Tang	
	Dinner			

The meeting place is at the **Zhihua Hall (智华楼), Research Institute of Mathematical Science, Jiangsu Normal University** on the morning of July 7, and in the **Halls of the Hotel** for other time. Dinner on July 7 is served at **Conference Center Platinum Rui Hall 1 (北楼二楼会议中心铂瑞一厅)**, and at **Excellent Western Restaurant (南楼一楼卓越西餐厅)** for all other lunch and dinner.

July 7 (Monday)

Session 1

Chairman: Yingchao Xie

08:30-09:00 *OPENING*

09:00-10:00 *Presentation*

Break

Chairman: Zenghu Li

10:30-11:00 Kening Lv (Sichuan University, Sichuan)

Turbulence, Lyapunov exponents, and SRB measures in infinite-dimensional dynamical systems

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

Reflected jump diffusions on Ahlfors regular domains

11:30-12:00 Shui Feng (McMaster University, CA)

Diversity Index of the Hierarchical Dirichlet Process

Chairman: Zhen-Qing Chen

14:30-15:00 Feng-Yu Wang (Tianjin University, Tianjin)

Log-Harnack Inequality and Applications

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

Heat kernel estimates for Dirichlet forms degenerate at the boundary

15:30-16:00 Kyung-Youn Kim (Chung Hsing University, Taiwan, China)

Stability of heat kernel estimates under non-local Feynman–Kac perturbations for jump diffusions

Break

Chairman: Kening Lv

16:30-17:00 Takashi Kumagai (Kyoto University, Japan)

Scaling limit for Brownian motions on the l-level Sierpinski gaskets

17:00-17:30 Zhan Shi (AMSS Chinese Academy of Sciences, Beijing)

The effective resistance problem of the critical series-parallel graph

17:30-18:00 Jie-Ming Wang (Beijing Institute of Technology, Beijing)

Boundary harnack principle for diffusion with jumps in metric measure spaces

July 7 (Monday)

Session 2

Chairman: Shui Feng

14:30-15:00 Xia Chen (The University of Tennessee，Knoxville)

Small deviation for the mutual intersection local times of Brownian motions

15:00-15:30 Zechun Hu (Sichuan University, Sichuan)

Limit behavior of linearly edge-reinforced random walks on the half-line

15:30-16:00 Xinyi Li (Peking University, Beijing)

Favorite Sites of Random Walk in Two and Higher Dimensions

Break

Chairman: Xia Chen

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

Large deviations for empirical measures and additive functionals of affine processes

17:00-17:30 Huaiqian Li (Tianjin University, Tianjin)

A New Proof of the Maz'ya–Shaposhnikova Formula for Kolmogorov–Fokker–Plank Operators

17:30-18:00 Ziyu Liu (Peking University, Beijing)

Exponential mixing and LDP for randomly forced wave equations

July 8 (Tuesday)

Session 1

Chairman: Hui He

08:30-09:00 Deli Li (Online) (Lakehead University, Canada)

A general logarithmic asymptotic behavior for partial sums of i.i.d random variables

09:00-09:30 Vladimir Vatutin (Steklov Mathematical Institute, Russia)

On the prospective minimum of the random walk conditioned to stay non-negative and reduced branching processes in random environment

09:30-10:00 Huaming Wang (Anhui Normal University, Anhui)

Limit distribution for sums of inhomogeneous Markovian Bernoulli variables

Break

Chairman: Lihu Xu

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

Risk-sensitive zero-sum continuous-time Markov games with unbounded rates and finite horizon

11:00-11:30 Wenzhao Zhang (Fuzhou University, Fuzhou)

Discrete-time nonstationary average stochastic games

11:30-12:00 Zhongyang Sun (Qufu Normal University, Qufu)

Optimal Dividend, Investment, and Risk Control Strategies under a Dynamic Contagion Model

Chairman: Zhan Shi

14:30-15:00 Renming Song (University of Illinois Urbana-Champaign, USA)

On the extinction time and maximal displacement of critical branching killed Lévy processes

15:00-15:30 Hui He (Beijing Normal University, Beijing)

Limit of Brownian trees with exponential weight on its height

15:30-16:00 Tianyi Bai (Chinese Academy of Sciences, Beijing)

Central limit theorem of critical branching random walks

Break

Chairman: Renming Song

16:30-17:00 Xiaowen Zhou (Concordia University, CA)

Boundary behavior for simple exchangeable fragmentation coagulation process in critical slow regime

17:00-17:30 Yuanyuan Liu (Central South University, Changsha)

Bounds on the Solution to Poissons Equation for General Harris Chains

17:30-18:00 Xu Yang (North Minzu University, Yinchuan)

Extinction behaviour for the positive mutually interacting continuous-state population dynamics

July 8 (Tuesday)

Session 2

Chairman: Yan-Xia Ren

8:30-9:00 Fubao Xi (Beijing Institute of Technology, Beijing)

The tail behavior of Cox-Ingersoll-Ross processes with state-dependent switching

9:00-9:30 Yutao Ma (Beijing Normal University, Beijing)

The exact convergence rate of extreme eigenvalues for complex Ginibre ensembles

09:30-10:00 Zhenzhong Zhang (Donghua University, Shanghai)

Ergodicity of diffusions with semi-Markov switching

Break

Chairman: Fubao Xi

10:30-11:00 Chenggui Yuan (Swansea Universtiy, UK)

Path-distribution dependent SDEs: well-posedness and asymptotic log-Harnack inequality

11:00-11:30 Haifeng Huo (Guangxi University of Science and Technology, Guangxi)

Mean-variance optimality for first passage partially observable Markov decision processes

11:30-12:00 Zhong-Wei Liao (Beijing Normal University at Zhuhai, Zhuhai)

Viscosity solution approach to continuous-time decision processes with history-dependent policies

Chairman: Chenggui Yuan

14:30-15:00 Xian-Yuan Wu (Capital Normal University, Beijing)

Efficient Approximate Minimum-Rényi Entropy Couplings

15:00-15:30 Yuqiang Li (East China Normal University, Shanghai)

Probably Approximately Correct O-Policy Prediction of Contextual Bandits

15:30-16:00 Michael Choi (National University of Singapore, Singapore)

Improving the convergence of Markov chains via permutations and projections

Break

Chairman: Jian Wang

16:30-17:00 Liming Wu (on line) (Harbin Institute of Technology, Harbin)

Transport-information inequality and concentration for Markov process in large time

17:00-17:30 Bo Wu (Fudan University, Shanghai)

Functional inequalities for diffusions on path/loop space

17:30-18:00 Ling-Di Wang (Henan University, Henan)

Stability Criteria and Inverse Problems of Discrete-Time Markov Chains in General State Spaces

July 9 (Wednesday)

Session 1

Chairman: Xiaowen Zhou

08:30-09:00 Zenghu Li (Beijing Normal University, Beijing)

Asymptotics of Derrida-Retaux type recursive models

09:00-09:30 Yaozhong Hu (online) (University of Alberta at Edmonton, CA)

Strong solution of stochastic differential equations with discontinuous and unbounded coefficients

09:30-10:00 Jiayan Guo (Beijing Normal University, Beijing)

Precise large deviations for the total population of subcritical branching processes with immigration in random environment

Break

Chairman: Feng-Yu Wang

10:30-11:00 Shizhan Fang (University of Bourgogne, France)

Remarks on Itô stochastic processes

11:00-11:30 Jiang-Lun Wu (Swansea Universtiy, UK)

On BSDEs driven by guassian noise

11:30-12:00 Panpan Ren (City University of Hong Kong, Hong Kong)

Bi-coupling approach and It's applications

Chairman: Shizhan Fang

14:30-15:00 Nicolas Privault (online) (Nanyang Technological University, Singapore)

Wasserstein distance estimates for jump-diffusion processes

15:00-15:30 Soobin Cho (University of Illinois Urbana-Champaign, USA)

Approximate factorizations for non-symmetric jump processes

15:30-16:00 Huiping Chen (Chinese Academy of Sciences, Beijing)

Ergodicity for singular stochastic Ginzburg-Landau equation via complex wiener-itô integral

Break

Chairman: Dayue Chen

16:30-17:00 Quansheng Liu (online) (Université de Bretagne-Sud, France)

Kesten-stigum theorem for a branching process in a random environment and perron-frobenius theorem for products of positive random matrices

17:00-17:30 Jieliang Hong (Southern University of Science and Technology, Shenzhen)

Rescaled SIR epidemic processes converge to super-Brownian motion in four or more dimensions

17:30-18:00 Yue-Shuang Li (Capital University of Economics and Business, Beijing)

The first nontrivial eigenpair of single birth(death) processes

July 9 (Wednesday)

Session 2

Chairman: Wei Liu (JSNU)

08:30-09:00 Tusheng Zhang (University of Science and Technology of China, Hefei)

Stochastic partial differential equations on moving domains

09:00-09:30 Jianhai Bao (Tianjin University, Tianjin)

Long-time error bound of Euler type schemes for non-dissipative SDEs

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

Probability distances for SDEs driven by stable processes with different stability indices

Break

Chairman: Tusheng Zhang

10:30-11:00 Xiang-Dong Li (Chinese Academy of Sciences, Beijing)

Random Matrix Theory, Stochastic Analysis and Statistical Mechanics

11:00-11:30 Jinghai Shao (Tianjin University, Tianjin)

Subgeometric ergodicity for diffusion processes with Markovian regime-switching

11:30-12:00 Fan Yang (Tsinghua University, Beijing)

Localization-delocalization and quantum chaos transition for a random block matrix model

Chairman: Xiang-Dong Li

14:30-15:00 Zhao Dong (Chinese Academy of Sciences, Beijing)

Ergodic and mixing properties of the 2d Navier-Stokes equations with a degenerate multiplicative gaussian noise

15:00-15:30 Fang Chen (Peking University, Beijing)

Algorithms for two-person zero-sum average semi-Markov games

15:30-16:00 Shuaiqi Zhang (China University of Mining & Technology, Beijing)

Sub-diffusive Black-Scholes model and Girsanov transform

Break

Chairman: Zhao Dong

16:30-17:00 Wei Liu (WHU) (Wuhan University, Wuhan)

Concentration inequalities and exponential convergence for mean-field weakly interacting particle system and McKean-Vlasov equation

17:00-17:30 Xing Huang (online) (Tianjin University, Tianjin)

Exponential ergodicity for Mckean-Vlasov SDEs with singular interactions

17:30-18:00 Bin Tang (Peking University, Beijing)

Large deviation principle for the stationary solutions of stochastic functional differential equations with infinite delay

July 10 (Thursday)

Session 1

Chairman: Xianping Guo

08:30-09:00 Yong-Hua Mao (Beijing Normal University, Beijing)

Hua's input-output models: from the standpoint of Markov chains

09:00-09:30 Lu-Jing Huang (Fujian Normal University, Fuzhou)

The spectral dimensions for one-dimensional critical long-range percolation

09:30-10:00 Guangqiang Lan (Beijing University of Chemical Technology, Beijing)

Mixed truncated euler method for stochastic delay differential equations with concave diffusion coefficients

Break

Chairman: Yong-Hua Mao

10:30-11:00 Dejun Luo (Chinese Academy of Sciences, Beijing)

Enhanced dissipation and Lyapunov exponents for stochastic transport diffusion equations with small molecular diffusivity and noise intensity

11:00-11:30 Xinxin Chen (Beijing Normal University, Beijing)

BRW in IID environment: Yaglom theorem and Stein method

11:30-12:00 Fei Pu (Beijing Normal University, Beijing)

Sharp upper bounds on hitting probabilities for the solution to the stochastic heat equation on the line

July 10 (Thursday)

Session 2

Chairman: Xian-Yuan Wu

08:30-09:00 Xing Wang (Renmin University of China, Beijing)

Research on detection of trace evidence using independence regularized LDA and functional analysis with FTIR spectroscopy data

09:00-09:30 Hao Tang (Tianjin University, Tianjin)

Global Regularity and Finite-Time Singularity in Some SPDEs

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

A Phase Transition for the Two-Dimensional Random Field Ising/FK-Ising Model

CENTRAL LIMIT THEOREM OF CRITICAL BRANCHING RANDOM WALKS

Tianyi BAI *Chinese Academy of Sciences, China*, E-mail: tianyi.bai73@amss.ac.cn

Abstract: We present recent progress on central limit theorem for the range of a critical branching random walk (CBRW) in $\mathbb{Z}^d$ conditioned to be infinite. Law of large number for range of CBRW was given by Le Gall and Lin in 2016, and we aim at strengthening the result to a central limit theorem, based on general theory for stationary process and relation between height process of CBRW and random walk excursions. This talk is based on an ongoing joint work with Yueyun Hu.

LONG-TIME ERROR BOUND OF EULER-TYPE SCHEMES FOR NON-DISSIPATIVE SDES

Jianhai BAO *Tianjin University, China*, E-mail: jianhaibao@tju.edu.cn

Abstract: Under Lyapunov and monotone conditions, via the reflection coupling, we establish a long-time error bound between the laws of the exact solution and the associated Euler type scheme. Whereas, to handle the issue we are interested in, the reflection coupling approach no longer works when the driven noise is multiplicative. For such case, we leverage the generalized coupling approach to investigate the associated long-time error bound. In particular, the theory derived is applicable to functional SDEs and SDEs with piecewise continuous drifts.

ALGORITHMS FOR TWO-PERSON ZERO-SUM AVERAGE SEMI-MARKOV GAMES

Fang CHEN *Peking University, China*, E-mail: chenfang@pku.edu.cn

Abstract: We consider a two-person zero-sum semi-Markov game under the expected average reward criterion. By introducing an auxiliary parametric stochastic game and establishing the continuity of its value with respect to the parameter, we propose a novel approach to prove the existence of a solution to the Shapley equation. Based on this approach, we derive an approximation algorithm for the value of the semi-Markov game. Additionally, an iterative algorithm is developed to compute ε-saddle point equilibria. Finally, we provide an example to illustrate our results.

ERGODICITY FOR SINGULAR STOCHASTIC GINZBURG-LANDAU EQUATION VIA COMPLEX WIENER-ITÔ INTEGRAL

Huiping CHEN *Academy of Mathematics and Systems Science, Beijing*, E-mail: chenhp@amss.ac.cn

Abstract: We investigate the ergodicity of the complex Ginzburg-Landau equation with a general nonlinear term on the two-dimensional torus, driven by complex-valued space-time white noise. Due to the roughness of the noise, the solution to this singular equation is a distribution-valued stochastic process. As a result, the nonlinear term is ill-defined and requires renormalization. Using the theory of complex multiple Wiener-Itô integrals, we define the Wick products of the linear part, namely the stochastic heat equation with dispersion, and provide a simple criterion for estimating them. Based on the estimates for Wick products, we establish global well-posedness by combining the fixed point theorem with a bounds. Finally, we prove ergodicity by applying the Krylov-Bogoliubov theorem along with an asymptotic coupling argument for a large dissipation coefficient.

SMALL DEVIATION FOR THE MUTUAL INTERSECTION LOCAL TIMES OF BROWNIAN MOTIONS

Xia CHEN *University of Tennessee, USA*, E-mail: xchen3@tennessee.edu

Key words: Small deviation, Brownian motion, random walk, intersection local time

Abstract: This talk is concerned with the sharp estimates of the probability that a mutual intersection local time between two 1-dimentional independent Brownian motions takes small values. The idea is to compare this probability to the non-intersection probability of two Brownian paths. Some further problems are asked for its multi-dimensional versions.

This talk is based on a collaborative work (published in TJP) with Jian Song

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QUENCHED INVARIANCE PRINCIPLE FOR L_2 INTEGRABLE LONG RANGE RANDOM WALK IN BALANCED ENVIRONMENTS

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

Abstract: We will prove the quenched invariance principle for a class of L_2-integrable long range random walk in balanced random environments. Moreover, a version of maximum inequality and weak Harnack inequality with tail terms have been also obtained. This is based on a joint work with Zhen-Zhou Zheng.

BRW IN IID ENVIRONMENT: YAGLOM THEOREM AND STEIN METHOD

Xinxin CHEN *Beijing Normal University, China*, E-mail: xinxin.chen@bnu.edu.cn

Abstract: We consider a branching random walk in i.i.d. random environment where the branching law depends on the spatial environment and the motion is simple random walk. In some critical branching case, we prove the Yaglom theorem via Stein method. This is a joint work with Chenlin Gu and Zhiqi Zhao.

REFLECTED JUMP DIFFUSIONS ON AHLFORS REGULAR DOMAINS

Zhen-Qing CHEN *University of Washington and CUHKSZ*, E-mail: zqchen@wu.edu

Abstract: In this talk, we study two-sided heat kernel estimates for symmetric reflected jump diffusions on Ahlfors regular domains in metric measure spaces. For symmetric jump processes on metric measure spaces, it has been established that mixed stable-like heat kernel estimates hold if and only if a two-sided jump kernel condition and a cut-off Sobolev inequality are satisfied. So the key is to establish the cut-off Sobolev inequality for reflected jump diffusions on Ahlfors regular domains. For this, we show that there is a suitable extension operator from the Ahlfors regular domain to the whole metric space.

Based on a joint work with Shiping Cao.

APPROXIMATE FACTORIZATIONS FOR NON-SYMMETRIC JUMP PROCESSES

Soobin CHO *University of Illinois Urbana-Champaign, USA*, E-mail: soobinc@illinois.edu

Abstract: In this talk, we first discuss approximate factorizations of heat kernels and Green functions for purely discontinuous Markov processes. Under natural conditions, we show that the approximate factorization of the heat kernel is equivalent to that of the Green function. In the second part, we will discuss applications of these factorizations to derive two-sided heat kernel estimates for three classes of processes: stable-like processes with critical killing in $C^{1,Dini}$ open sets; killed stable-like processes with low regularity coefficients; and non-symmetric stable processes in $C^{1,2\text{-}Dini}$ open sets. In particular, we obtain sharp, explicit two-sided estimates for the killed and censored stable processes in $C^{1,Dini}$ open sets. This is based on joint work with Professor Renming Song (UIUC).

IMPROVING THE CONVERGENCE OF MARKOV CHAINS VIA PERMUTATIONS AND PROJECTIONS

Michael C.H. CHOI *National University of Singapore, Singapore*, E-mail: mchchoi@nus.edu.sg

Abstract: This talk aims at improving the convergence to equilibrium of finite ergodic Markov chains via permutations and projections. First, we prove that a specific mixture of permuted Markov chains arises naturally as a projection under the KL divergence or the squared-Frobenius norm. We then compare various mixing properties of the mixture with other competing Markov chain samplers and demonstrate that it enjoys improved convergence. This geometric perspective motivates us to propose samplers based on alternating projections to combine different permutations and to analyze their rate of convergence. We give necessary, and under some additional assumptions also sufficient, conditions for the projection to achieve stationarity in the limit in terms of the trace of the transition matrix. We proceed to discuss tuning strategies of the projection samplers when these permutations are viewed as parameters. Along the way, we reveal connections between the mixture and a Markov chain Sylvester's equation as well as assignment problems, and highlight how these can be used to understand and improve Markov chain mixing. We provide two examples as illustrations. In the first example, the projection

sampler (with a suitable choice of the permutation) improves upon Metropolis-Hastings in a discrete bimodal distribution with a reduced relaxation time from exponential to polynomial in the system size, while in the second example, the mixture of permuted Markov chain yields a mixing time that is logarithmic in system size (with high probability under random permutation), compared to a linear mixing time in the Diaconis-Holmes-Neal sampler. Finally, we provide numerical experiments on simple statistical physics models to illustrate the improved mixing performance of the proposed projection samplers over standard Metropolis-Hastings. This is based on joint work with Max Hird (UCL) and Youjia Wang (NUS).

PROBABILITY DISTANCES FOR SDES DRIVEN BY STABLE PROCESSES WITH DIFFERENT STABILITY INDICES

Chang-Song DENG *Wuhan University, China*, E-mail: dengcs@whu.edu.cn

Abstract: Consider two SDEs with the same drift but driven by symmetric stable processes with stability indices $\alpha \in (1, 2)$ and $\beta \in (1, 2)$, respectively. We establish upper bounds for the Wasserstein-1 and total variation distances between their ergodic measures, and show that our bounds are sharp for the Ornstein–Uhlenbeck processes. As an interesting application, we also present a stability estimate for fractional Poisson PDEs.

ERGODIC AND MIXING PROPERTIES OF THE 2D NAVIER-STOKES EQUATIONS WITH A DEGENERATE MULTIPLICATIVE GAUSSIAN NOISE

Zhao DONG *AMSS, Beijing*, E-mail: dzhao@amt.ac.cn

Abstract: In this talk, we establish the ergodic and mixing properties of stochastic 2D Navier-Stokes equations driven by a highly degenerate multiplicative Gaussian noise. The noise can appear in as few as four directions, and its intensity depends on the solution. The case of additive Gaussian noise was previously treated by Hairer and Mattingly [Ann. of Math., 164(3):993–1032, 2006]. To derive the ergodic and mixing properties in the present setting, we employ Malliavin calculus to establish the asymptotically strong Feller property. The primary challenge lies in proving the "invertibility" of the Malliavin matrix, which differs fundamentally from the additive case

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REMARKS ON ITÔ STOCHASTIC PROCESSES

Shizhan FANG *IMB, UMR 5584, University of Burgundy-Europe, France*, E-mail: shizan.fang@u-bourgogne.fr

Abstract: A new inequality in L^d of Krylov type for Bass-Chen diffusion processes is established in this talk through an overview revisiting various aspects of Itô-Tanaka tricks for non-degenerated diffusion processes.

DIVERSITY INDEX OF THE HIERARCHICAL DIRICHLET PROCESS

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

Abstract: The Dirichlet process is a discrete random measure specified by a concentration parameter and a base distribution. It is a fundamental prior distribution in Bayesian nonparametrics. The hierarchical Dirichlet process generalizes the Dirichlet process by randomizing the base distribution through a draw from another Dirichlet process. It is motivated by the study of groups of clustered data, where the group specific Dirichlet processes are linked through an intergroup Dirichlet process. In this talk, which is based on joint work with J.E. Paguyo, we give a brief introduction to the diversity index and the hierarchical Dirichlet process. We then discuss our recent work on the central limit theorem of the homozygosity (Simpson index) of the hierarchical Dirichlet process, as the corresponding concentration parameters tend to infinity.

LARGE DEVIATIONS FOR EMPIRICAL MEASURES AND ADDITIVE FUNCTIONALS OF AFFINE PROCESSES

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

Abstract: For a regular affine process whose diffusion component satisfies a Hörmander-type condition and whose boundary is unreachable, we derive the strong Feller property and the open set irreducibility. Under additional dissipative conditions and integrability assumptions on the jump measures, we establish large deviation principles for the empirical measures and some additive functionals of the affine process. (This talk is based on a joint work with Hui Jiang, Zhi Qu and Youzhou Zhou.)

PRECISE LARGE DEVIATIONS FOR THE TOTAL POPULATION OF SUBCRITICAL BRANCHING PROCESSES WITH IMMIGRATION IN RANDOM ENVIRONMENT

Jiayan GUO *Beijing Normal University, Beijing*, E-mail: guojiayan@bnu.edu.cn

Abstract: We focus on the partial sum $S_n = X_1 + \cdots + X_n$ of the subcritical branching process with immigration in a random environment, under the condition that the immigration η is regularly varying. When the tail of offspring ξ is lighter than that of the immigration η, the annealed precise large deviation probabilities for S_n are specified, that is, uniformly for $x \geq x_n$, $\mathbb{P}(S_n - \mathbb{E}S_n > x) \sim cn\mathbb{P}(\eta > x)$, where c is some constant related to the distribution of ξ. It is revealed that two kinds of randomness contribute to the determination of the uniform bound x_n: the deviation between $\{S_n\}$ and its quenched mean, and the deviation between the quenched mean and the annealed mean. This is a joint work with Professor Wenming Hong.

RISK-SENSITIVE ZERO-SUM CONTINUOUS-TIME MARKOV GAMES WITH UNBOUNDED RATES AND FINITE HORIZON

Xianping GUO *Sun Yat-sen University, Guangzhou*, E-mail: mcsgxp@mail.sysu.edu.cn

Abstract: This talk concerns with an finite-horizon two-player zero-sum risk-sensitives to chastic game in continuous-time Markov chains with Borel state and action spaces. The model accommodates unbounded reward rates, transition rates, and terminal reward functions, while permitting history dependent policies. The risk metric is the exponential utility function. Under suitable conditions we establish the existence of a solution to the corresponding Shapley equation (SE) through an approximation technique. Using the SE and an extension of Dynkin's formula, we prove the existence of saddle-point equilibrium and demonstrate that the stochastic game's value is the unique solution to the SE. Furthermore, we develop a value iteration algorithm for approximating the stochastic game. Finally, we illustrate our main findings through an example.

A PHASE TRANSITION FOR THE TWO-DIMENSIONAL RANDOM FIELD ISING/FK-ISING MODEL

Chenxu HAO *Peking University, China*, E-mail: haochenxu@pku.edu.cn

Abstract: We study the total variation (TV) distance between the laws of the 2D Ising/FK-Ising model in a box of side-length N with and without an i.i.d. Gaussian external field with variance ϵ^2. Letting the external field strength $\epsilon = \epsilon(N)$ depend on the size of the box, we derive a phase transition for each model depending on the order of $\epsilon(N)$. For the random field Ising model, the critical order for ϵ is N^{-1}. For the random field FK-Ising model, the critical order depends on the temperature regime: for $T > T_c$, $T = T_c$ and $T \in (0, T_c)$ the critical order for ϵ is, respectively, $N^{-\frac{1}{2}}$, $N^{-\frac{15}{16}}$ and N^{-1}. In each case, as $N \to \infty$ the TV distance under consideration converges to 1 when ϵ is above the respective critical order and converges to 0 when below. The talk is based on a joint work with Fenglin Huang (PKU) and Aoteng Xia (PKU).

LIMIT OF BROWNIAN TREES WITH EXPONENTIAL WEIGHT ON ITS HEIGHT

Hui HE *Beijing Normal University, Beijing*, E-mail: fqgao@bnu.edu.cn

Abstract: We consider a Brownian continuum random tree τ and its local time process at level s, say Z_s, which evolves as a Feller branching diffusion. Denote by $H(\tau)$ and $\mathbb{N}$ the height and the law of the tree τ, respectively. Let $\mu \in \mathbb{R}$ be a constant. We show that as $r \to \infty$,

$$\frac{\mathbb{N}\left[\mathrm{e}^{-\mu H(\tau)}, (\tau, Z) \in \cdot \,\middle|\, \int_0^\infty Z_s \mathrm{d}s = r\right]}{\mathbb{N}\left[\mathrm{e}^{-\mu H(\tau)} \,\middle|\, \int_0^\infty Z_s \mathrm{d}s = r\right]} \xrightarrow{d} \mathrm{Law}\left[(\tau^\mu, Z^\mu)\right], \quad \text{in a local sense,}$$

where if $\mu < 0$, then τ^μ is a Kesten tree and if $\mu > 0$, then τ^μ is the so-called Poisson tree constructed in Abraham, Delmas and He (2022, arXiv) by studying the local limits of τ. Moreover, Z^μ is the local time process of τ^μ, which is a new diffusion, as already proved by Overbeck in 1994 by studying the Martin boundary of Z. We give a new representation of this diffusion using an elementary SDE with a Poisson immigration. The talk is based on some ongoing works with Romain Abraham, Jean-François Delmas and Meltem Ünel.

RESCALED SIR EPIDEMIC PROCESSES CONVERGE TO SUPER-BROWNIAN MOTION IN FOUR OR MORE DIMENSIONS

Jieliang HONG *Southern University of Science and Technology, Shenzhen*, E-mail: hongjl@sustech.edu.cn

Abstract: In dimensions $d \geq 4$, by choosing a suitable scaling parameter, we show that the rescaled spatial SIR epidemic process converges to a super-Brownian motion with drift, thus complementing the previous results by Lalley (*Prob. Th. Rel. Fields*, **144** (2009), 429–469) and Lalley-Zheng (*Prob. Th. Rel. Fields*, **148** (2010), 527–566) on the convergence of SIR epidemics in $d \leq 3$. The scaling parameters we choose also agree with the corresponding asymptotics for the critical probability p_c of the range-R bond percolation on Z^d as $R \to \infty$.

STRONG SOLUTION OF STOCHASTIC DIFFERENTIAL EQUATIONS WITH DISCONTINUOUS AND UNBOUNDED COEFFICIENTS

Yaozhong HU *University of Alberta, Canada*, E-mail: y.hu@ualberta.ca

Abstract: In this talk I will present a joint work with Dr. Qun Shi on the existence and uniqueness of strong solution of the following d-dimensional stochastic differential equation (SDE) driven by Brownian motion:

$$dX_t = b(t, X_t)dt + \sigma(t, X_t)dB_t, \quad X_0 = x,$$

where B is a d-dimensional standard Brownian motion; the diffusion coefficient σ is a Hölder continuous and uniformly non-degenerate $d \times d$ matrix-valued function and the drift coefficient b may be discontinuous and unbounded, not necessarily in L_p^q, extending the previous works to discontinuous and unbounded drift coefficient situation. The idea is to combine the Zvonkin's transformation with the Lyapunov function approach. Zvonkin's transformation is a one-to-one (and quasi-isometric) transformation of a phase space that allows us to pass from a diffusion process with nonzero drift coefficient to a process without drift. To this end, we need to establish a local version of the connection between the solutions of the SDE up to the exit time of a bounded connected open set D and the associated partial differential equation on this domain. As an interesting by-product, we establish a localized version of the Krylov estimates and a localized version of the stability result of the stochastic differential equations of discontinuous coefficients.

LIMIT BEHAVIOR OF LINEARLY EDGE-REINFORCED RANDOM WALKS ON THE HALF-LINE

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

Abstract: We study linearly edge-reinforced random walks on the half-line, where each edge $\{x, x+1\}$ has the initial weight $x^\alpha \ln^\beta x$ for $x > 1$ and 1 for $x = 0, x = 1$, and each time an edge

is traversed, its weight is increased by δ. It is known that the walk is recurrent if and only if $\alpha < 1$ or $\alpha = 1$ and $\beta \leq 1$. The aim of this paper is to study the limit behavior of the walk in the recurrent regime. The talk is based on a joint work with Renming Song and Li Wang.

THE SPECTRAL DIMENSIONS FOR ONE-DIMENSIONAL CRITICAL LONG-RANGE PERCOLATION

Lu-Jing HUANG *Fujian Normal University, China*, E-mail: huanglj@fjnu.edu.cn

Abstract: Consider the critical long-range percolation on Z, where an edge connects i and j independently with probability $1 - \exp\{\beta \int_i^{i+1} \int_j^{j+1} |u-v|^{-2} dudv\}$ for $|i-j| > 1$ for some fixed $\beta > 0$ and with probability 1 for $|i-j| = 1$. We prove that both the quenched and annealed spectral dimensions of the associated simple random walk are $2/(1+\delta)$, where $\delta \in (0,1)$ is the exponent of the effective resistance in the LRP model, as derived in [10, Theorem 1.1]. Our work addresses an open question from [7, Section 5]. This is based on a joint work with Zherui Fan.

EXPONENTIAL ERGODICITY FOR MCKEAN-VLASOV SDEs WITH SINGULAR INTERACTIONS

Xing HUANG *Tianjin University, China*, E-mail: xinghuang@tju.edu.cn

Abstract: In this paper, for a class of McKean-Vlasov SDEs with singular interactions, i.e. the drifts are Lipschitz continuous under $\|\cdot\|_{k*}$ in the distribution variable for some $k \in (d, \infty]$, the exponential ergodicity in $\|\cdot\|_{p*}$ is derived for any $p \in [k, \infty]$. This together with a regularity estimate as well as the reflection coupling for decoupled SDEs deduces the exponential ergodicity in L^1-Wasserstein distance.

MEAN-VARIANCE OPTIMALITY FOR FIRST PASSAGE PARTIALLY OBSERVABLE MARKOV DECISION PROCESSES

Haifeng HUO *Guangxi University of Science and Technology, China*, E-mail: xiaohuo08ok@163.com

Abstract: This paper studies mean-variance optimality for first passage partially observable Markov decision processes (POMDPs).Based on the filter equation, the optimization problem of mean-variance can be equivalently reformulated as completely observable Markov decision processes (COMDPs).Under suitable conditions, firstly we establish the optimality equation satisfied by the value function. Then we prove the existence and uniquness of the solution to the optimality equation, and the existence of the optimal policy. Finally, we give a example to illustrate the effectiveness of calculate the value function and the optimal policy by using the value iteration algorithm.

STABILITY OF HEAT KERNEL ESTIMATES UNDER NON-LOCAL FEYNMAN-KAC PERTURBATIONS FOR JUMP DIFFUSIONS

Kyung-Youn KIM *Chung Hsing University, Taiwan, China*, E-mail: kykim@nchu.edu.tw

Abstract: We study the stability of two-sided heat kernel estimates for a broad class of (possibly non-symmetric) jump-type diffusion processes on metric measure spaces, under non-local Feynman–Kac perturbations. In addition, we derive the parabolic Harnack inequality through an approach that combines probabilistic and analytic techniques. This is a joint work with Zhen-Qing Chen(University of Washington) and Lidan Wang(Nankai University).

HEAT KERNEL ESTIMATES FOR DIRICHLET FORMS DEGENERATE AT THE BOUNDARY

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

Abstract: In this talk, we discuss estimates on the heat kernels of discontinuous symmetric Markov processes including ones with jump kernels degenerate at the boundary. Depending on the regions where the parameters belong, the heat kernels estimates have three different forms, two of them are qualitatively different from all previously known heat kernel estimates. We also discuss the processes killed either by a critical potential or upon hitting the boundary of the half-space. Their heat kernel estimates have the approximate factorization property with survival probabilities decaying as a power of the distance to the boundary, where the power depends on the critical potential.

This is a joint work with Soobin Cho (University of Illinois, USA), Renming Song (University of Illinois, USA) and Zoran Vondraček (University of Zagreb, Croatia)

SCALING LIMIT FOR BROWNIAN MOTIONS ON THE L-LEVEL SIERPINSKI GASKETS

Takashi KUMAGAI *Waseda Univeristy, Japan*, E-mail: t-kumagai@waseda.jp

Key words: Sierpinski gasket, fractal, Brownian motion, scaling limit, transition density.

Mathematical Subject Classification: 28A80 (primary), 60J25, 60J35, 60K50.

Abstract: In two dimensions, the l-level Sierpinski gasket SG(l) is obtained by splitting an equilateral triangle into a collection of l^2 equilateral triangles of equal size and with the same total area, retaining only the $l(l+1)/2$ triangles with the same orientation as the original triangle, and then iterating this procedure indefinitely. In this talk, we will present a result that the canonical diffusions on the spaces SG(l), $l \geq 2$, can be rescaled to yield Brownian motion on the initial triangle. Our argument also applies to the analogous higher-dimensional Sierpinski gaskets. Moreover, we derive a corresponding scaling limit for the associated transition densities. This is a joint work with B.M Hambly (Oxford) and D.A. Croydon (Kyoto).

MIXED TRUNCATED EULER METHOD FOR STOCHASTIC DELAY DIFFERENTIAL EQUATIONS WITH CONCAVE DIFFUSION COEFFICIENTS

Guangqiang LAN *Beijing University of Chemical Technology, Beijing*, E-mail: langq@buct.edu.cn

Abstract: In this talk, we are concerned with strong convergence of the given mixed truncated Euler-Maruyama method for stochastic delay differential equations with concave diffusion coefficients. We prove that, when the drift term satisfies some suitable local Lipschitz and one-sided Lipschitz conditions and the diffusion term satisfies some concave condition, the mixed truncated Euler-Maruyama method strongly converges to the exact solution in the L^P sense. One example is presented to interpret the theory.

A NEW PROOF OF THE MAZ'YA-SHAPOSHNIKOVA FORMULA FOR KOLMOGOROV-FOKKER-PLANK OPERATORS

Huaiqian LI *Tianjin University, Tianjin*, E-mail: huaiqian@tju.edu.cn

Abstract: We present a new proof of the Maz'ya–Shaposhnikova formula for the Kolmogorov-Fokker-Planck operator, recently established in [Ann. Sc. Norm. Super. Pisa Cl. Sci. (5) Vol. XXIII (2022) 837–875]. In contrast to the original proof based on Besov norm approximations, we provide a concise and robust alternative approach using L^p-norm approximations.

A GENERAL LOGARITHMIC ASYMPTOTIC BEHAVIOR FOR PARTIAL SUMS OF I.I.D. RANDOM VARIABLES

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

Abstract: Let $0 < p < 2$. Let $\{X, X_n; n \geq 1\}$ be a sequence of independent and identically distributed **B**-valued random variables and set $S_n = \sum_{i=1}^{n} X_i$, $n \geq 1$. In this talk, an analogue of large deviation principle is provided under assumption $S_n/n^{1/p} \to_{\mathbb{P}} 0$ (i.e., the weak law of large numbers) only. The main tools employed in proving this result are the symmetrization technique and three powerful inequalities established by Hoffmann-Jørgensen (1974), de Acosta (1981), and Ledoux and Talagrand (1991), respectively. As a special case of this result, the main results of Hu and Nyrhinen (2004) are not only improved, but also extended.

This is a joint work with Professor Yu Miao at Henan Normal University, China.

RANDOM MATRIX THEORY, STOCHASTIC ANALYSIS AND STATISTICAL MECHANICS

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

Abstract: In this talk, I will briefly discuss the deep connection between Random Matrix Theory, Stochastic Analysis and Statistical Mechanics. In particular, I will present some recent results on the Law of Large Numbers, the Propagation of Chaos, the Central Limit Theorem, the longtime asymptotic behavior and the phase transition of the empirical measure process of the Dyson Brownian motion associated with the unitary invariant random matrices ensemble with a general confining potential field.

FAVORITE SITES OF RANDOM WALK IN TWO AND HIGHER DIMENSIONS

Xinyi LI *Peking University*, E-mail: xinyili@bicmr.pku.edu.cn

Abstract: On the trace of a discrete-time simple random walk on $\mathbb{Z}^d$, $d \geq 2$, we consider the evolution of favorite sites, i.e., sites that achieve the maximal local time at a certain time. For $d = 2$, we show that almost surely three favorite sites occur simultaneously infinitely often and eventually there is no simultaneous occurrence of four favorite sites. For $d \geq 3$, we derive sharp asymptotics of the number of favorite sites. This answers an open question of Erdős and Révész (1987). This talk is based on a joint work (available at arXiv:2409.00995) with Chenxu HAO (Peking University), Izumi OKADA (The University of Tokyo) and Yushu ZHENG (CAS-AMSS).

PROBABLY APPROXIMATELY CORRECT OFF-POLICY PREDICTION OF CONTEXTUAL BANDITS

Yuqiang LI *East China Normal University*, E-mail: yqli@stat.ecnu.edu.cn

Abstract: This talk is concentrated on off-policy evaluations of contextual bandits by conformal prediction intervals which can control marginal coverage with finite-sample theoretical guarantees and are particularly suited for safety-critical applications. It is investigated how to achieve coverage conditional on a pre-collected offline dataset by introducing probably approximately correct prediction intervals. Our approach primarily relies on rejection sampling and split conformal prediction. Algorithms are constructed and their theoretical properties, including finite-sample guarantees and asymptotic limits, are established. Simulation experiments are conducted to validate their effectiveness.

THE FIRST NONTRIVIAL EIGENPAIR OF SINGLE BIRTH PROCESSES

Yue-Shuang LI *Capital University of Economics and Business, Beijing*, E-mail: yueshuang-li@cueb.edu.cn

Abstract: Consider single-birth(death) Q-matrices. First, a sufficient condition for having real spectrum is given. Besides, three kinds of variational formula for the first nontrivial eigenvalues are presented, from which, the explicit upper and lower bounds for the eigenvalues are obtained. Additionally, using the first hitting time, a new formula for the corresponding eigenfunction is

presented. As an application, an iteration algorithm for the first nontrivial eigenpair corresponding to the Q-matrix is obtained. This talk is based on a joint work with Professor Yonghua Mao and Processor Yuhui Zhang.

ASYMPTOTICS OF DERRIDA-RERAUX TYPE RECURSIVE MODELS

Zenghu LI *Beijing Normal University, Beijing*, E-mail: lizh@bnu.edu.cn

Abstract: A discrete-time max-type recursive process was introduced by Derrida and Retaux (J. Stat. Phys., 2014) in the study of the depinning transition in the limit of strong disorder. There are interesting problems regarding to its phase transition and behavior near the criticality. We study a similar recursive model with a geometric offspring distribution, which is a special case of the generalized Derrida-Retaux recursive process defined by Hu and Shi (J. Stat. Phys., 2018). The class of geometric type marginal distributions remains invariant during the evolution of the process, so the marginal distributions are determined by two parameters. We give precise longtime asymptotic expansions of the distributional parameters in the supercritical, subcritical and critical cases. From those we derive asymptotic expressions for the sustainability probability, conditional distribution, first moment, and generating function of the process. In the critical case, the results are consistent with, and even more precise than, the four conjectures about the classical Derrida-Retaux model proposed by Chen, Derrida and others (2019). The talk is based on a joint work with Run Zhang.

VISCOSITY SOLUTION APPROACH TO CONTINUOUS-TIME DECISION PROCESSES WITH HISTORY-DEPENDENT POLICIES

Zhong-Wei LIAO *Beijing Normal University at Zhuhai, CN*, E-mail: zhwliao@hotmail.com

Abstract: This paper investigates the optimal control problems for the finite horizon continuous time decision processes with history-dependent control policies. We develop the compactification method to show the existence of optimal policies based on the application of Skorokhod's representation of Markov chains. Then, the value function is characterized as the unique viscosity solution to certain differential-difference Hamilton-Jacobi-Bellman equation. This work is accomplished in cooperation with Yanhua Mi and Jinghai Shao.

KESTEN-STIGUM THEOREM FOR A BRANCHING PROCESS IN A RANDOM ENVIRONMENT AND PERRON-FROBENIUS THEOREM FOR PRODUCTS OF POSITIVE RANDOM MATRICES

Ion GRAMA *Université Bretagne Sud, France*
Quansheng LIU *Université Bretagne Sud (University of South Brittany), France*, E-mail: quansheng.liu@univ-ubs.fr
Thi Trang NGUYEN *Posts and Telecommunications Institute of Technology, Vietnam*

Abstract: Let $Z_n = (Z_n(1), \cdots, Z_n(d))$ be a supercritical d-type branching process in an independent and identically distributed random environment $\xi = (\xi_0, \xi_1, \cdots)$. Given the environment, all particles behave independently, and each r-type particle of generation n gives birth to new particles of the next generation of types $1, ..., d$ according to a probability distribution $p^r(\xi_n) = \{p^r_k(\xi_n) : k \in \mathbb{N}^d\}$ on $\mathbb{N}^d$, depending on ξ_n and r, for each $r \in \{1, \cdots, d\}$. We establish a Kesten-Stigum type theorem, which gives a precise description of the growth rate of the population size, and which builds a bridge between the branching process and products of nonnegative random matrices. For the proof, we establish a Perron-Frobenius type theorem for products of stationary and ergodic nonnegative random matrices, which gives a precise description of the size of such products, and which offers a close link with the ergodic theory for stationary and ergodic sequences of real random variables.

CONCENTRATION INEQUALITIES AND EXPONENTIAL CONVERGENCE FOR MEAN-FIELD WEAKLY INTERACTING PARTICLE SYSTEM AND MCKEAN-VLASOV EQUATION

Wei LIU *Wuhan University, Wuhan*, E-mail: wliu.math@whu.edu.cn

Abstract: In this talk, we will show concentration inequalities, exponential convergence in the Wasserstein metric, and uniform-in-time propagation of chaos for the mean-field weakly interacting particle system related to McKean-Vlasov equation. By means of the known approximate componentwise reflection coupling and with the help of some new cost function, we obtain explicit estimates for those three problems, avoiding the technical conditions in the known results. Our results apply to possibly multi-well confinement potentials, and interaction potentials W with bounded second mixed derivatives which are not too big, so that there is no phase transition. Several examples are provided to illustrate the results.

BOUNDS ON THE SOLUTION TO POISSON'S EQUATION FOR GENERAL HARRIS CHAINS

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

Abstract: Poisson's equation is fundamental to the study of Markov chains, and arises in connection with martingale representations and central limit theorems for additive functionals, perturbation theory for stationary distributions, and average reward Markov decision process problems. In this paper, we develop a new probabilistic representation for the solution of Poisson s equation, and use Lyapunov functions to bound this solution representation explicitly. In addition to the new bound and representation, we also develop a computable uniform bound on marginal expectations for Harris chains, and a computable bound on the potential kernel representation of the solution to Poisson s equation. The results are applied to derive nonasymptotic mean squared error bounds for Markov chains.

This talk is based on joint works with Peter Glynn and Na Lin.

EXPONENT MIXING AND LDP FOR RANDOMLY FORCED WAVE EQUATIONS

Ziyu LIU *Peking University, Beijing*, E-mail: ziyu@pku.edu.cn

Abstract: We explore the statistical properties of randomly forced wave equations. We begin by establishing a new criterion for exponential mixing and large deviations of random dynamical systems. This criterion is then applied to random nonlinear wave equations with degenerate damping, critical nonlinearity, and physically localized noise. The verification of this criterion is naturally linked to topics in deterministic systems, such as exponential asymptotic compactness in dynamical systems, global stability of the locally damped equations, and the controllability and stabilization properties.

ENHANCED DISSIPATION AND LYAPUNOV EXPONENTS FOR STOCHASTIC TRANSPORT-DIFFUSION EQUATIONS WITH SMALL MOLECULAR DIFFUSIVITY AND NOISY INTENSITY

Dejun LUO *AMSS, Chinese Academy of Sciences, Beijing*, E-mail: luodj@amss.ac.cn

Abstract: We consider linear passive scalar transport-diffusion equation subject to a velocity field which is white noise in time and is mainly active at small scales in space. Our purpose is to study the enhancement of dissipation and decay in a regime different from the previous work [Flandoli-Galeati-Luo, JDE 2024], namely small molecular diffusion and small noise intensity corresponding to small turbulent kinetic energy. The noise specification is carefully tuned to Kolmogorov theory of turbulent fluids. The talk is based on a joint work with Prof. Flandoli.

TURBULENCE, LYAPUNOV EXPONENTS, AND SRB MEASURE IN INFINITY-DIMENSIONAL DYNAMICAL SYSTEMS

Kening LV *Sichuan University, Sichuan*, E-mail:kening2014@126.com

Abstract: In this talk, I will present several results related to Lyapunov exponents, SRB measures, entropy, and horseshoes in the context of infinite-dimensional dynamical systems. I will also discuss recent work on the ergodicity and statistical dynamics of the 2D Navier-Stokes equation, driven by both time-dependent deterministic and stochastic forces. Additionally, I will explore the connection between SRB measures and turbulence.

THE EXACT CONVERGENCE RATE OF EXTREME EIGENVALUES FOR COMPLEX GINIBRE ENSEMBLES

Yutao MA *Beijing Normal University*, E-mail: mayt@bnu.edu.cn

Abstract: Let X be a n×n random matrix with entries being i.i.d. standard normals and let $(\sigma_1, \cdots, \sigma_n)$ be its eigenvalues. It is known that both max $|\sigma_i|$ and max $Re(\sigma_i)$ converge weakly to the Gumbel distribution after proper scaling. We give the exact rate of this convergence.

HUA'S INPUT-OUTPUT MODELS: FROM THE STANDPOINT OF MARKOV CHAINS

Yong-Hua MAO *Beijing Normal University*, E-mail: mayt@bnu.edu.cn

Abstract: In his celebrating input-output model, Loo-Keng Hua's revealed a profound and original economic phenomena, which indicates that eventually there exists at least one product used up. This is called the "collapse" theorem. Mu-Fa Chen gave a Markov chain proof for the "collapse" theorem. In this talk, we find a new and equivalent quantity description of the collapse, from which we give the quantity estimate for the upper bound of the collapse time. The method is to use the strong ergodicity for the Markov chain. The absorbing Markov chain is introduced to describe the input-output model with consumption, and the continuous-time evolution equation is also presented to settle the real production process.

WASSERSTEIN DISTANCE ESTIMATES FOR JUMP-DIFFUSION PROCESSES

Nicolas PRIVAULT *Nanyang Technological University, Singapore*, E-mail: nprivault@ntu.edu.sg

Abstract: We derive Wasserstein distance bounds between the probability distributions of a stochastic integral (Itô) process with jumps $(X_t)_{t\in[0,T]}$ and a jump-diffusion process $(X_t^*)_{t\in[0,T]}$. Our bounds are expressed using the stochastic characteristics of $(X_t)_{t\in[0,T]}$ and the jump-diffusion coefficients of $(X_t^*)_{t\in[0,T]}$ evaluated in X_t, and apply in particular to the case of different jump characteristics. Our approach uses stochastic calculus arguments and L^p integrability results for the flow of stochastic differential equations with jumps.

SHARP UPPER BOUNDS ON HITTING PROBABILITIES FOR THE SOLUTION TO THE STOCHASTIC HEAT EQUATION ON THE LINE

Fei PU *Beijing Normal University, Singapore*, E-mail: fei.pu@bnu.edu.cn

Abstract: We study the upper bounds on hitting probabilities for the solution to the stochastic heat equation with multiplicative noise. Using the techniques of Malliavin calculus for locally nondegenerate random variables, we derive a Gaussian-type upper bound on the joint density of the random vector which consists of the solution to stochastic heat equation with multplicative noise and the maximum of the increment of the solution to stochatic heat equation with additive noise. This together with approximation of increment of the solution to stochastic heat equation with multiplicative noise by that of additive noise, leads to the sharp upper bounds on hitting probabilities in terms of d-6 dimensional Hausdorff measure. This is based on collabration with with R.C. Dalang and D. Nualart.

BI-COUPLING APPROACH AND IT'S APPLICATIONS

Panpan REN *City University of Hong Kong, Hong Kong*, E-mail: rppzoe@gmail.com

Abstract: By developing a new technique called the bi-coupling argument, we estimate the relative entropy between different diffusion processes in terms of the distances of initial distributions and drift-diffusion coefficients. As an application, 1)the entropy-cost inequality and exponential ergodicity in entropy is established for distribution dependent stochastic Hamiltonian system associated with nonlinear Fokker-Planck equations and 2) distribution dependent SDEs with singular interactions, which include the Coulomb/Riesz/Biot-Savart kernels as typical examples, we derive the well-posedness and regularity estimates by establishing the entropy-cost inequality.

SUBGEOMETRIC ERGODICITY FOR DIFFUSION PROCESSES WITH MARKOVIAN REGIME-SWITCHING

Jinghai SHAO *Tianjin University, China*, E-mail: shaojh@tju.edu.cn

Abstract: We shall introduce the criteria to justify the subgeometric ergodicity of diffusion processes with Markovian regime-switching. Based on the criteria proposed in this work, one can deal with the regime-switching diffusion processes, which are subgeometrically ergodic in some regimes but transient in others. Based on a common Lyapunov function method, we establish an averaging type criterion to justify the recurrence of regime-switching processes. In particular, we can deal with the critical case, which has been studied only for several special regime-switching processes.

THE EFFECTIVE RESISTANCE PROBLEM OF THE CRITICAL SERIES-PARALLEL GRAPH

Zhan SHI *AMSS, Chinese Academy of Sciences*, E-mail: zhanmath@gmail.com

Abstract: The effective resistance of the critical random series-parallel graph was studied by Hambly and Jordan (2004), who predicted its asymptotic behaviour. The conjecture, simple and innocent-looking, was strengthened by Addario-Berry et al. (2020), and furthermore by Derrida (2022). I am going to make some elementary discussions on these conjectures. Joint work with Xinxing Chen (Shanghai) and Thomas Duquesne (Paris).

ON THE EXTINCTION TIME AND MAXIMAL DISPLACEMENT OF CRITICAL BRANCHING KILLED LÉVY PROCESSES

Renming SONG *University of Illinois Urbana-Champaign, USA*, E-mail: rsong@illinois.edu

Abstract: In this talk, I will present some recent results on the asymptotic behaviors of the tails of the extinction time and maximal displacement of critical branching killed Levy processes. This talk is based on a joint paper with Haojie Hou and Yanxia Ren.

OPTIMAL DIVIDEND, INVESTMENT, AND RISK CONTROL STRATEGIES UNDER A DYNAMIC CONTAGION MODEL

Zhongyang SUN *Qufu Normal University*, E-mail: zysun@qfnu.edu.cn

Abstract: This paper proposes a jump-diffusion model for risky assets, in which the jump component is governed by a multidimensional dynamic contagion process that captures contagion risks induced by both endogenous mechanisms and exogenous shocks. The insurer aims to maximize the expected discounted utility of dividends through the joint optimization of dividend distribution, policy issuance and surplus investment. The model also incorporates dependence between financial and insurance markets. Using the dynamic programming principle and the associated Hamilton-Jacobi-Bellman (HJB) equation, we prove the existence of optimal strategies under a logarithmic utility function. A verification theorem is established based on the ergodic property of the contagion process. Under a specific factor structure, explicit optimal strategies are derived. Numerical examples illustrate how the optimal strategies evolve with the contagion intensity.

LARGE DEVIATION PRINCIPLE FOR THE STATIONARY SOLUTIONS OF STOCHASTIC FUNCTIONAL DIFFERENTIAL EQUATIONS WITH INFINITE DELAY

Bin TANG *Peking University*, E-mail: tangbin@math.pku.edu.cn

Abstract: We investigate the large deviation principle (LDP) of the stationary solutions of stochastic functional differential equations (SFDEs) with infinite delay under small random perturbation. First, we demonstrate the existence and uniqueness of the corresponding stationary solutions. Second, by the weak convergence approach, we show the uniform large deviation principle for the solution maps, and then prove the LDP for stationary solutions. Furthermore, we obtain the LDP for invariant measures of SFDEs through the LDP for stationary solutions and the contraction principle. It gives a new proof approach to the LDP for invariant measures without using quasi-potential.

GLOBAL REGULARITY AND FINITE-TIME SINGULARITY IN SOME SPDES

Hao TANG *Tianjin University, Tianjin*, E-mail: haotang@tju.edu.cn

Abstract: This talk presents recent advances concerning global regularity and finite-time blow-up in some SPDEs arising from fluid dynamics and chemotaxis. First, we establish global regularity for a specific class of noise structures. Turning to blow-up dynamics, we focus on the linear noise case, providing a blow-up criterion, characterizing the blow-up scenario, and determining the blow-up rate. Finally, I will discuss some unresolved issues where further insight is needed. I would be grateful for any feedback or suggestions that could enhance my understanding of these issues.

ON THE PROSPECTIVE MINIMUM OF THE RANDOM WALK CONDITIONED TO STAY NON-NEGATIVE AND REDUCED BRANCHING PROCESSES IN RANDOM ENVIRONMENT

Vladimir VATUTIN *Steklov Mathematical Institute, Moscow, RUSSIA*, E-mail: vatutin@mi-ras.ru
Elena Dyakonova *Steklov Mathematical Institute, Moscow, RUSSIA*, E-mail: elena@mi-ras.ru

KEY WORDS: random walks, stable distributions, conditional limit theorems

MATHEMATICAL SUBJECT CLASSIFICATION: Primary 60G50; Secondary 60J80, 60G52

Abstract: Let

$$S_0 = 0, \quad S_n = X_1 + ... + X_n, \ n \geq 1,$$

be a random walk whose increments belong without centering to the domain of attraction of a stable law with scaling constants a_n, that provide convergence as $n \to \infty$ of the distributions of the sequence $\{S_n/a_n, n = 1, 2, ...\}$ to this stable law. Let $L_{r,n} = \min_{r \leq m \leq n} S_m$ be the minimum of the random walk on the interval $[r, n]$. We show that

$$\lim_{r,k,n \to \infty} \mathbf{P}\left(L_{r,n} \leq y a_k | S_n \leq t a_k, L_{0,n} \geq 0\right), t \in (0, \infty)$$

can have five different expressions, the forms of which depend on the relationships between the parameters r, k and n.

Properties of the prospective minimum of the random walk are important in studying the distribution of the population size of reduced branching processes evolving in non-favorable random environment.

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LOG-HARNACK INEQUALITY AND APPLICATIONS

Feng-Yu WANG *Tianjin University, Tianjin*, E-mail: wangfy@tju.edu.cn

Abstract: As an inverse version of the celebrated Talagrand transport-cost inequality, the log-Harnack inequality was introduced by the speaker in 2010 to characterize the geometry and regularity properties of diffusion processes. Since then this inequality has been established and applied to various models including SDEs, SPFEs and DDSDEs. This talk gives a brief review on the study of log-Harnack inequality developed in the past 15 year.

LIMIT DISTRIBUTION FOR SUMS OF INHOMOGENEOUS MARKOVIAN BERNOULLI VARIABLES

Huaming WANG *Anhui Normal University, Wuhu*, E-mail: hmking@ahnu.edu.cn
Joint work with **Shuxiong ZHANG**

Abstract: Let $\{\eta_i\}_{i \geqslant 1}$ be a sequence of dependent Bernoulli random variables. While the Poisson approximation $\sum_{i=1}^{n} \eta_i$ for the distribution of has been extensively studied in the literature, this paper establishes novel convergence regimes characterized by non-Poisson limits. Specifically, when $\{\eta_i\}_{i \geqslant 1}$ exhibits a Markovian dependence structure, we show that $\sum_{i=1}^{n} \eta_i$, under appropriate scaling, converges almost surely or in distribution as $n \to \infty$ to a random variable with geometric or gamma distribution. As concrete applications, we derive the distribution of the number of times the population size in certain branching processes attains a given level.

BOUNDARY HARNACK PRINCIPLE FOR DIFFUSION WITH JUMPS IN METRIC MEASURE SPACES

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

Abstract: A non-scale invariant BHP on an open set is obtained for a class of discontinuous Hunt processes on metric measure spaces under some conditions on the exit distribution, Green function and the jumping density function. The result shows that the BHP on any open set holds for a class of regular symmetric Dirichlet forms in metric measure spaces having both the strongly local term and the pure-jump term that admits a two-sided heat kernel estimates and for a class of non-symmetric diffusion processes with jumps in non-divergence form in $\mathbb{R}^d$. Based on a joint work with Professor Z.-Q. Chen.

STABILITY CRITERIA AND INVERSE PROBLEMS OF DISCRETE-TIME MARKOV CHAINS IN GENERAL STATE SPACES

Ling-Di WANG *Henan University*, E-mail: wanglingdi@henu.edu.cn

Abstract: Stability is a fundamental topic in the study of Markov processes. This talk will present several sufficient or necessary conditions for the stability of Markov processes, covering key properties such as ergodicity and non- ergodicity, f-regular ergodicity, sub-geometric ergodicity. We establish these results by constructing bounds on the moments of hitting times. More generally, the talk will also discuss bounds on the moments of additive functionals of first hitting times for these processes. The primary tool used in this research is the theory of minimal nonnegative solutions.

RESEARCH ON DETECTION OF TRACE EVIDENCE USING INDEPENDENCE REGULARIZED LDA AND FUNCTIONAL ANALYSIS WITH FTIR SPECTROSCOPY DATA

Xing WANG *University of Renmin University of China, Beijing*, E-mail: wangxing@ruc.edu.cn

Abstract: Infrared spectroscopy is key for forensic evidence ID. This paper tackles the challenge of analyzing infrared spectral data—typically small in size, high - dimensional, with wide spectral bands and very similar images. It proposes combining regularized discriminant IR - LDA and FDA for feature and feature - band extraction. Based on real - world paint cases with slight differences in basic material components, the study found: 1. Compared with the commonly used principal component analysis (PCA) noise reduction and generalized linear lasso path method, regular discrimination is helpful in the extraction of infrared spectral landmark features and has a good performance of double robustness with high accuracy of extracted features and high accuracy of material evidence identification; 2. Based on the extraction of landmark features, the simultaneous confidence band method in functional data analysis is further used to estimate

local continuous spectral bands through spline regression estimation covariance function. The experimental results show that regular discrimination and functional data analysis effectively extract infrared spectral sparse marker features, accurately identify further physical evidence, and quantitatively estimate local continuous spectral segments.

FUNCTIONAL INEQUALITIES FOR DIFFUSIONS ON PATH/LOOP SPACE

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

Abstract: In this talk, we first introduce recent developments of functional inequalities on the path/loop space. After that, we will present associated functional inequalities with respect to diffusion Wiener measure and diffusion Bridge measure respectively.

ON BSDES DRIVEN BY GUASSIAN NOISE

Xiliang FAN *Anhui Normal University, China*
Jiang-Lun WU *Beijing Normal-Hong Kong Baptist University, China*, E-mail: jianglunwu@uic.edu.cn

Abstract: We are concerned with backward stochastic differential equations (BSDEs) and distribution dependent backward stochastic differential equations (DDBSDEs) driven by Gaussian noise. We first present upper and lower non-Gaussian bounds for the densities of the marginal laws of solutions to BSDEs driven by fractional Brownian motions. Then, we derive Gaussian estimates for the densities of BSDEs driven by a Gaussian process in the manner that the solution can be established via an auxiliary BSDE driven by a Brownian motion. As for DDBSDEs driven by Gaussian noise, after establishing the existence and uniqueness results, we show a comparison theorem and a new representation for DDBSDEs (which is even new for the case of the equations driven by Brownian motion). The obtained representation then leads to a novel converse comparison theorem. Finally, we derive transportation inequalities and Log-Sobolev inequalities via the stability of the Wasserstein distance and the relative entropy of measures under the homeomorphism condition. Talk is based on

- Xiliang Fan and Jiang-Lun Wu: Density estimates for the solutions of backward stochastic differential equations driven by Gaussian processes, *Potential Anal.*, **54** (2021), 483-501.
- Xiliang Fan and Jiang-Lun Wu: On distribution dependent BSDEs driven by Gaussian processes, *J. Differential Equations*, **426** (2025), 223-252.

TRANSPORT-INFORMATION INEQUALITY AND CONCENTRATION FOR MARKOV PROCESS IN LARGE TIME

Liming WU *I'Université Clermont-Auvergne / Harbin Institute of Technology, Harbin* , E-mail:wuliming@hit.edu.cn

Abstract: In this talk I will introduce the transport-information inequality， which characterizes the concentration inequality of empirical mean of reversible Markov process in large time. Several criteria and interesting examples are presented.

This talk is based on a series of joint works with many collaborators: F.Q. Gao, A. Guillin, Ch. Leonard, Y.T. Ma, N.Y. Wang, Y. Wang， N. Yao.

EFFICIENT APPROXIMATE MINIMUM-RÉNYI ENTROPY COUPLINGS

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

Abstract: The Rényi entropy is a natural generalization of Shannon entropy which depends on a parameter α. Given two probability distributions $\mathbf{p}$ and $\mathbf{q}$, the minimum Rényi entropy coupling is joint distribution of $\mathbf{p}$ and $\mathbf{q}$ with minimal Rényi entropy. We show in this paper that the greedy coupling proposed in Kocaoglu and Dimakis (2017) possesses a Rényi entropy exceeding the exact minimum value at most by $g(\alpha)$ bits. Here $g(\alpha)$ decreases to 0 as α tends to infinite, $g(\alpha) \leq 1$ for $\alpha \geq 0.3644$ and $g(\alpha)$ tends to $\log_2(e)/e \approx 0.53$ as α tends to 1.

THE TAIL BEHAVIOR OF COX-INGERSOLL-ROSS PROCESSES WITH STATE-DEPENDENT SWITCHING

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

Abstract: For a class of state-dependent switching Cox-Ingersoll-Ross processes, we first establish tail behavior results for stationary distributions in both finite and infinite regimes cases. Through auxiliary Markov chains, we then explicitly construct a comparison theorem specifically adapted for state-dependent switching diffusions. Finally, we derive sufficient recurrence conditions for infinite-regime cases. Our approach provides rigorous control of state-dependent switching component processes with Markov chains and remains applicable to broader classes of state-dependent switching diffusion processes. This is a joint work with Yafei Zhai (Beijing Institute of Technology).

LOCALIZATION-DELOCALIZATION AND QUANTUM CHAOS TRANSITION FOR A RANDOM BLOCK MATRIX MODEL

Fan YANG *Yau Mathematical Sciences Center, Tsinghua University*, E-mail: fyangmath@mail.tsinghua.edu.cn

Abstract: Consider a random block matrix model consisting of D random systems arranged along a circle, where each system is modeled by an independent $N \times N$ complex Hermitian Wigner matrix. The neighboring systems interact through an arbitrary deterministic $N \times N$ matrix A. We establish a localization-delocalization transition for the eigenvectors and a quantum chaos transition for the eigenvalues across the entire spectrum, including the spectral edges. More precisely, let $[E^-, E^+]$ denote the support of the limiting spectrum, and define $\kappa_E :=$

$|E - E^+| \wedge |E - E^-|$ as the distance of an energy $E \in [E^-, E^+]$ from the spectral edges. We prove that for eigenvalues near E, a transition in the local eigenvalue statistics, along with a localization-delocalization transition of the corresponding eigenvectors, occurs when $\|A\|_{\mathrm{HS}}$ crosses the critical threshold $(\kappa_E + N^{-2/3})^{-1/2}$. Based on joint work with Jiaqi Fan, Bertrand Stone, and Jun Yin.

EXTINCTION BEHAVIOUR FOR THE POSITIVE MUTUALLY INTERACTING CONTINUOUS-STATE POPULATION DYNAMICS

Xu YANG *North Minzu University* , E-mail: xuyang@nmu.edu.cn

Abstract: In this talk we consider a system of stochastic differential equations (SDEs) with two-way positive interaction driven by Brownian motions and spectrally positive-stable random measures. Such SDEs system can be identified as a Lotka-Volterra type population model with positive interaction. We find some close to sharp conditions for the extinction behavior. This talk is based on a recent joint works with Jie Xiong and Xiaowen Zhou.

PATH-DISTRIBUTION DEPENDENT SDES: WELL-POSEDNESS AND ASYMPTOTIC LOG-HARNACK INEQUALITY

Chenggui YUAN *Swansea University,UK*, E-mail: c.yuan@swansea.ac.uk

Abstract: In this talk, SDEs on $\mathbb{R}^d$ with coefficients depending on the path and distribution over the entire history are discussed. We first established the well-posedness and Lipschitz continuity in initial values under a local integrability condition on the time-spatial singular drift. Additionally, under a monotone condition, the asymptotic log-Harnack inequality is demonstrated, which extends the existing results derived in the distribution independent case. This is a joint work with Feng-Yu Wang and Xiaoyu Zhao.

SUB-DIFFUSIVE BLACK-SCHOLES MODEL AND GIRSANOV TRANSFORM

Shuaiqi ZHANG *China University of Mining and Technology, China*, E-mail: shuaiqiz@hotmail.com

Abstract: In this talk, we propose a novel Black-Scholes model under which the stock price processes are modeled by stochastic differential equations driven by a sub-diffusion. The new framework can capture the less financial activity phenomenon during the bear markets while having the classical Black-Scholes model as its special case. The sub-diffusive spot market is arbitrage-free but is in general incomplete. We study the pricing for European-style contingent claims under this new model. For this, we study Girsanov transform for sub-diffusions and use it to find risk-neutral probability measure for the new Black-Scholes model. Finally we derive the explicit formula for price of the European call option and show that it can be determined

by a partial differential equation (PDE) involving fractional derivative in time, which we coin a time-fractional Black-Scholes PDE.

STOCHASTIC PARTIAL DIFFERENTIAL EQUATIONS ON MOVING DOMAINS

Tusheng ZHANG *University of Science and Technology of China, China*, E-mail: tushengz@ustc.edu.cn

Abstract: In this talk, we will introduce the framework of stochastic partial differential equations (SPDEs) with non-homogeneous monotonicity to handle the SPDEs on moving domains. We will particularly focus on the stochastic Stefan problem on moving hypersurfaces and stochastic Navier-Stokes equations on moving domains.

DISCRETE-TIME NONSTATIONARY AVERAGE STOCHASTIC GAMES

Wenzhao ZHANG *Fuzhou University, China*, E-mail: zhangwenzhao1987@163.com

Abstract: In this talk, we focus on the discrete-time nonstationary stochastic games with average reward criteria. The state space is denumerable and the action space of players are Borel spaces, while the transition probability and reward functions can be changed with time. Meanwhile, the reward functions are allowed to be non-uniformly bounded. Under the suitable optimality conditions, we establish the average optimality equation and prove the existence of Nash equilibria.

ERGODICITY OF DIFFUSIONS WITH SEMI-MARKOV SWITCHING

Zhenzhong ZHANG *Donghua University, China*, E-mail: zzzhang@dhu.edu.cn

Abstract: In this talk, we focus on ergodicity and transience of SDEs driven by diffusion processes with semi-Markov switching. Some sufficient conditions for ergodicity of several classes of diffusion with semi-Markov switching are given. Furthermore, necessary and sufficient conditions for ergodicity of Ornstein Uhlenbeck diffusions with seimi-Markov switching are presented. As applications, some examples are provided to illustrate our results.

BOUNDARY BEHAVIOR FOR SIMPLE EXCHANGEABLE FRAGMENTATION-COAGULATION PROCESS IN CRITICAL SLOW REGIME

Xiaowen ZHOU *Concordia University, Canada*, E-mail:xiaowen.zhou@concordia.ca

Abstract: Boundary behavior for simple exchangeable fragmentation-coagulation process was studied first in Foucart (2022) and later in Foucart and Zhou (2022). But some critical cases were left unaddressed.

In this talk, for a critical simple exchangeable fragmentation-coagulation process in slow regime where the coagulation rate and fragmentation rate are of the same order, we show that there exist phase transitions for its boundary behavior at infinity depending on the asymptotics of the difference between the two rates, and find rather sharp conditions for different boundary behaviors.

This talk is based on joint work with Lina Ji.

Participants: (in order of the surname)

Tianyi Bai 白天衣 :
Chinese Academy of Sciences, Beijing.
E-mail: tianyi.bai73@amss.ac.cn

Jianhai Bao 鲍建海:
Tianjin University, Tianjin.
E-mail: jianhaibao@tju.edu.com

Bin Chen 陈彬:
Jiangsu Normal University, Xuzhou.
E-mail: bchen@jsnu.edu.cn

Dayue Chen 陈大岳:
Peking University, Beijing.
E-mail: dayue@math.pku.edu.cn

Fang Chen 陈方:
Peking University, Beijing.
E-mail: chenfang@pku.edu.cn

Huiping Chen 陈慧萍:
Chinese Academy of Sciences, Beijing.
E-mail: chenhp@amss.ac.cn

Jiarui Chen 陈佳睿:
Wuhan University, Wuhan.
E-mail: 2857721554@qq.com

Jinwen Chen 陈金文:
Tsinghua University, Beijing.

Lei Chen 陈磊:
Jiangsu Normal University, Xuzhou.
E-mail: chenlei@jsnu.edu.cn

Mu-Fa Chen 陈木法:
Beijing Normal University, Beijing & Jiangsu Normal University, Xuzhou.
E-mail: mfchen@bnu.edu.cn

Peng Chen 陈鹏:
Nanjing University of Aeronautics and Astronautics, Nanjing.

Shuikai Chen 陈舒凯:
Fujian Normal University, Fuzhou.
E-mail: skchen@fjnu.edu.cn

Tianyuan Chen 陈天元:
Jiangsu Normal University, Xuzhou.

Xia Chen 陈夏:
University of Tennessee, USA.
E-mail: xchen3@tennessee.edu

Xin Chen 陈昕:
Shanghai Jiao Tong University, Shanghai.
E-mail: chenxin217@sjtu.edu.cn

Xinxin Chen 陈昕昕:
Beijing Normal University, Beijing.
E-mail: xinxin.chen@bnu.edu.cn

Xinxing Chen 陈新兴:
Shanghai Jiao Tong University, Shanghai.
E-mail: chenxinx@sjtu.edu.cn

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

Zizhan Chen 陈子瞻:
Chinese Academy of Sciences, Beijing.

Lingyan Cheng 成灵妍:
Nanjing University of Science and Technology, Nanjing.
E-mail: cly@njust.edu.cn

Lijuan Cheng 程丽娟:
Hangzhou Normal University, Hangzhou.
E-mail: lijuan@hznu.edu.cn

Zhiwen Cheng 程志雯:
Taiyuan University of Technology, Taiyuan.
E-mail: chengziwen@tyut.edu.cn

Ziling Cheng 程子苓:
Southern University of Science and Technology, Shenzhen.
E-mail: chengzl@sustech.edu.cn

Soobin Cho 趙秀彬:
University of Illinois Urbana-Champaign, USA.
E-mail: soobinc@illinois.edu

Michael Choi 蔡卓轩:
National University of Singapore, Singapore.
E-mail: mchchoi@nus.edu.sg

Chang-Song Deng 邓昌松:
Wuhan University, Wuhan.
E-mail: dengcs@whu.edu.cn

Hao Ding 丁昊:
Chinese Academy of Sciences, Beijing.

Weiyong Ding 丁维勇:
Jiangsu Normal University, Xuzhou.
E-mail: mathdwy@hotmail.com

Hailing Dong 董海玲:
Shenzhen University, Shenzhen.

E-mail: hailing@szu.edu.cn

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

Zengji Du 杜增吉:
Jiangsu Normal University, Xuzhou.
E-mail: zjdu@jsnu.edu.cn

Zherui Fan 范哲睿:
Peking University, Beijing.
E-mail: zheruifan@pku.edu.cn

Xiliang Fan 范锡良:
Anhui Normal University, Wuhu.
E-mail: fanxiliang0515@163.com

Rongjuan Fang 方榕娟:
Fujian Normal University, Fuzhou.
E-mail: fangrj@fjnu.edu.cn

Shizan Fang 方诗赞:
University of Bourgogne, France.
E-mail: fang@u-bourgogne.fr

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

Qinling Fu 傅琴玲:
Beijing Normal University, Beijing.
E-mail: rcstoch@bnu.edu.cn

Wenxin Fu 符文鑫:
Beijing Normal University, Beijing.
E-mail: 202431130073@mail.bnu.edu.cn

Fuqing Gao 高付清:
Wuhan University, Wuhan.
E-mai: fqgao@whu.edu.cn

Wujun Gao 高武军:
Shenzhen Technology University, Shenzhen.
E-mail: gaowujun@sztu.edu.cn

Zhiqiang Gao 高志强:
Beijing Normal University, Beijing.
E-mail: gaozq@bnu.edu.cn

Caihong Gu 顾彩红:
Wuhan University, Wuhan.
E-mail: gucaihong@whu.edu.cn

Jiayan Guo 郭嘉言:
Beijing Normal University, Beijing.

E-mail: guojiayan@mail.bnu.edu.cn

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

Chenxu Hao 郝晨旭:
Perking University, Beijing.
E-mail: haochenxu@pku.edu.cn

Jiaqing Hao 郝佳晴:
Tianjin University, Tianjin.

Yifei Hao 郝一菲:
Beijing Normal University, Beijing.
E-mail: Haoyf@mail.bnu.edu.cn

Hui He 何辉:
Beijing Normal University, Beijing.
E-mail: hehui@bnu.edu.cn

Jieliang Hong 洪杰梁:
Southern University of Science and Technology, Shenzhen.
E-mail: hongjl@sustech.edu.cn

Wei Hong 洪伟:
Jiangsu Normal University, Xuzhou.
E-mail: weihong@jsnu.edu.cn

Wenming Hong 洪文明:
Beijing Normal University, Beijing.
E-mail: wmhong@bnu.eud.cn

Haojie Hou 侯浩杰:
Beijing Institute of Technology, Beijing.
E-mail: houhaojie@bit.edu.cn

Yuewen Hou 侯月文:
Fujian Normal University, Fuzhou.

Eryan Hu 胡二彦:
Tianjin University, Tianjin.
E-mail: eryan.hu@tju.edu.cn

Wenjie Hu 胡闻婕:
Jiangsu Normal University, Xuzhou.

Xinchen Hu 胡鑫晨:
Beijing Normal University, Beijing.
E-mail: huxc@mail.bnu.edu.cn

Yanyan Hu 胡艳艳:
Beijing Institute of Technology, Beijing.
E-mail: 1241010771@qq.com

Yaozhong Hu 胡耀忠:

University of Alberta at Edmonton, CA.
E-mail: yaozhong@ualberta.ca

Zechun Hu 胡泽春:
Sichuan University, Chengdu.
E-mail: zchu@scu.edu.cn

Shangyun Hua 华上云:
Jiangsu Normal University, Xuzhou.

Guan Huang 黄冠:
Hangzhou Normal University, Hangzhou.

Lu-Jing Huang 黄璐静:
Fujian Normal University, Fuzhou.
E-mail: lujingh@fjnu.edu.cn

Xing Huang 黄兴:
Tianjin University, Tianjin.
E-mail: xinghuang@tju.edu.cn

Haifeng Huo 霍海峰:
Guangxi University of Science and Technology, Liuzhou.
E-mail: xiaohuo08ok@163.com

Huijie Ji 籍慧洁:
Shanxi Normal University, Xi'an.
E-mail: jihuijie@163.com

Hui Jiang 蒋辉:
Nanjing University of Aeronautics and Astronautics, Nanjing.
E-mail: huijiang@nuaa.edu.cn

Yu Jiang 蒋宇:
Wuhan University, Wuhan.
E-mail: 2832752368@qq.com

Xinhu Jin 靳兴胡:
Hefei University of Technology, Hefei.
E-mail: xinghujin@hfut.edu.cn

Kyung-Yong Kim 金璟允:
Chung Hsing University, Taiwan, China.
E-mail: kykim@nchu.edu.tw

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

Takashi Kumagai:
Kyoto University, Japan.
E-mail: kumagai@kurims.kyoto-u.ac.jp

Guangqiang Lan 兰光强:
Beijing University of Chemical Technology, Beijing.
E-mail: langq@mail.buct.edu.cn

Huaiqian Li 黎怀谦:
Tianjin University, Tianjin.
E-mail: huaiqian@tju.edu.cn

Deli Li 李德立:
Lakehead University, Canada.
E-mail: dli@lakeheadu.ca

Doudou Li 李豆豆:
Beijing University of Technology, Beijing.
E-mail: lidd@bjut.edu.cn

Jianrui Li 李健睿:
Tianjin University, Tianjin.

Jionghui Li 李炯慧:
Jiangsu Normal University, Xuzhou.

Junping Li 李俊平:
Central South University, Changsha.
E-mail: jpli@csu.edu.cn

Miaomiao Li 李苗苗:
Northwestern Polytechnical University, Xi'an.

Peisen Li 李培森:
Beijing Institute of Technology, Beijing.
E-mail: peisenli@bit.edu.cn

Ruinan Li 李瑞囡:
Shanghai University of Finance and Economics, Shanghai.
E-mail: ruinanli@amss.ac.cn

Shihu Li 李石虎:
Jiangsu Normal University, Xuzhou.
E-mail: shihuli@jsnu.edu.cn

Xiang-Dong Li 李向东:
Chinese Academy of Sciences, Beijing.
E-mail: xdli@amt.ac.cn

Xinyi Li 李欣意:
Peking University, Beijing.
E-mail: xinyili@bicmr.pku.edu.cn

Ying Li 李英:
Xiangtan University, Xiangtan.
E-mail: liying@xtu.edu.cn

Yuqiang Li 李育强:
East China Normal University, Shanghai.
E-mail: yqli@stat.ecnu.edu.cn

Yue Li 李月:
University of Science and Technology of China, Hefei.

Yueling Li 李月玲:
Jiangsu Normal University, Xuzhou.
E-mail: lylmath@jsnu.edu.cn

Yue-Shuang Li 李月爽:
Capital University of Economics and Business, Beijing.
E-mail: yueshuang-li@cueb.edu.cn

Yun Li 李云:
Jiangsu Normal University, Xuzhou.
E-mail: liyun@jsnu.edu.cn

Zenghu Li 李增沪:
Beijing Normal University, Beijing.
E-mail: lizh@bnu.edu.cn

Shengli Liang 梁盛利:
Southern University of Science and Technology, Shenzhen.
E-mail: liangsl@sustech.edu.cn

Cenyu Liao 廖涔宇:
Beijing Normal University, Beijing.
E-mail: liaocy@mail.bnu.edu.cn

Zhong-Wei Liao 廖仲威:
Beijing Normal University at Zhuhai, Zhuhai.
E-mail: zhwliao@hotmail.com

Fengya Lin 林风雅:
Hangzhou Normal University, Hangzhou.

Huonan Lin 林火南:
Fujian Normal University, Fuzhou.
E-mail: linhn@fjnu.edu.cn

Guoping Liu 刘国平:
Huazhong University of Science and Technology, Wuhan.

Kexin Liu 刘珂欣:
Xiamen University, Xiamen.

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

Wei Liu 刘伟 (JSNU):
Jiangsu Normal University, Xuzhou.
E-mail: weiliu@jsnu.edu.cn

Wei Liu 刘伟 (WHU):
Wuhan University, Wuhan.
E-mail: wliu.math@whu.edu.cn

Yao Liu 刘瑶:
Fujian Normal University, Fuzhou.
E-mail: tayunzhuiyue@126.com

Yong Liu 刘勇:
Peking University, Beijing.
E-mail: liuyong@math.pku.edu.cn

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

Ziyu Liu 刘子愉:
Peking University, Beijing.
E-mail: ziyu@pku.edu.cn

Dejun Luo 罗德军:
Chinese Academy of Sciences, Beijing.
E-mail: luodj@amss.ac.cn

Kening Lv 吕克宁:
Sichuan University, Chengdu.
E-mail: keninglu2014@126.com

Heng Ma 马恒:
Peking University, Beijing.
E-mail: hengmamath@gmail.com

Jin Ma 马进:
Shandong Technology and Business University, Yantai.

Shaojuan Ma 马少娟:
North Minzu University, Yinchuan.
E-mail: sjma@nmu.edu.cn

Yajing Ma 马雅静:
Capital Normal University, Beijing.
E-mail: mayajing121@126.com

Yutao Ma 马宇韬:
Beijing Normal University, Beijing.
E-mail: mayt@bnu.edu.cn

Wei Mao 毛伟:
Jiangsu Second Normal University, Nanjing.
E-mail: mwzy365@126.com

Yong-Hua Mao 毛永华:
Beijing Normal University, Beijing.
E-mail: maoyh@bnu.edu.cn

Xujia Meng 孟栩嘉:
Beijing Normal University, Beijing.
E-mail: 202321130122@mail.bnu.edu.cn

Liying Mou 牟丽颖:
Tianjin University, Tianjin.

Liangliang Miao 缪亮亮:
Jiangsu Second Normal University, Nanjing.

Yajuan Pan 潘雅娟:
Wuhan University, Wuhan.
E-mail: yajuanpan@whu.edu.cn

Haozhang Peng 彭浩彰:
University of Oslo, Norway.

Xuhui Peng 彭旭辉:
Hunan Normal University, Changsha.
E-mail: xhpeng@hunnu.edu.cn

Xue Peng 彭雪:
Sichuan University, Sichuan.
E-mail: pengxuemath@scu.edu.cn

Nicolas Privault:
Nanyang Technological University, Singapore.
E-mail: nprivault@ntu.edu.sg

Fei Pu 蒲飞:
Beijing Normal University, Beijing.
E-mail: fei.pu@bnu.edu.cn

Lianyong Qian 钱连勇:
Jiangsu Normal University, Xuzhou.

Panpan Ren 任盼盼:
City University of Hong Kong, Hong Kong.
E-mail: rppzoe@gamil.com

Yan-Xia Ren 任艳霞:
Peking University, Beijing.
E-mail: yxren@math.pku.edu.cn

Yiming Ren 任一鸣:
Jiangsu Normal University, Xuzhou.

Jinghai Shao 邵井海:
Tianjin University, Tianjin.
E-mail: shaojh@bnu.edu.cn

Guangjun Shen 申广君:
Anhui Normal University, Wuhu.
E-mail: gjshen@ahnu.edu.cn

Xiangyu Shi 史祥雨:
Jiangsu Normal University, Xuzhou.

Yinghui Shi 时颖慧:
Jiangsu Normal University, Xuzhou.
E-mail: shiyinghui@jsnu.edu.cn

Zhan Shi 施展:
Chinese Academy of Sciences, Beijing.
E-mail: shizhan@amss.ac.cn

He Song 宋贺:
Huaiyin Normal University, Huai'an.
E-mail: songhe@hytc.edu.cn

Renming Song 宋仁明:
University of Illinois Urbana-Champaign, USA.
E-mail: rsong@illinois.edu

Yanhong Song 宋延红:
Zhongnan University of Economica and Law, Wuhan.
E-mail: songyh@zuel.edu.cn

Yulin Song 宋玉林:
Nanjing University, Nanjing.
E-mail: ylsong@nju.edu.cn

Xifeng Su 苏喜锋:
Beijing Normal University, Beijing.
E-mail: xfsu@bnu.edu.cn

Hongyan Sun 孙鸿雁:
China University of Geosciences, Beijing.
E-mail: sun_hy@cugb.edu.cn

Mingyang Sun 孙明阳:
Beijing Normal University, Beijing.
E-mail: sunmingyang@mail.bnu.edu.cn

Xiaobin Sun 孙晓斌:
Jiangsu Normal University, Xuzhou.
E-mail: xbsun@jsnu.edu.cn

Yingying Sun 孙莹莹:
Jiangsu Normal University, Xuzhou.

Zhongyang Sun 孙中洋:
Qufu Normal University, Qufu.
E-mail: zysun@qfnu.edu.cn

Jiangrui Tan 谭江睿:
Central South University, Changsha.
E-mail: jr_tan@mail.bnu.edu.cn

Bin Tang 唐斌:
Peking University, Beijing.
E-mail: tangbin@math.pku.edu.cn

Hao Tang 唐昊:
Tianjin University, Tianjin.
E-mail: haotang@tju.edu.cn

Wenxuan Tao 陶文轩:
University of Birmingham
E-mail: wxt399@student.bham.ac.uk

Vladimir Vatutin:

Steklov Mathematical Institute, Russia.
E-mail: vatutin@mi-ras.ru

Feng-Yu Wang 王凤雨:
Tianjin University, Tianjin.
E-mail: wangfy@tju.edu.cn

Huaming Wang 王华明:
Anhui Normal University, Wuhu.
E-mail: huamingking@mail.bnu.edu.cn

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

Jian Wang 汪键:
Hangzhou Normal University, Hangzhou.
E-mail: 20230078@hznu.edu.cn

Jie-Ming Wang 王洁明:
Beijing Institute of Technology, Beijing.
E-mail: wangjm@bit.edu.cn

Jing Wang 王婧:
Yili Normal University, Yili.
E-mail: wj_1229caycom@163.com

Li Wang 王丽:
Sichuan University, Sichuan.
E-mail: 2793757328@qq.com

Li Wang 王利:
Beijing University of Chemical Technology, Beijing.
E-mail: wangli@buct.edu.cn

Lidan Wang 王荔丹:
Nankai University, Tianjin.

Ling Wang 王玲:
Jiangsu Normal University, Xuzhou.

Ling-Di Wang 王玲娣:
Henan University, Kaifeng.
E-mail: wanglingdi@henu.edu.cn

Longmin Wang 王龙敏:
Nankai University, Tianjin.
E-mail: wanglm@nankai.edu.cn

Ran Wang 王冉:
Wuhan University, Wuhan.
E-mail: wangran@ustc.edu.cn

Tao Wang 王涛:
Jiangsu Normal University, Xuzhou.
E-mail: taowang@jsnu.edu.cn

Xing Wang 王星:
Renmin University of China, Beijing.
E-mail: wangxing@ruc.edu.cn

Xiong Wang 王雄:
Sun Yet-sen University, Guangzhou.
E-mail: xiongwang@ualberta.ca

Yingzhe Wang 王颖喆:
Beijing Normal University, Beijing.
E-mail: wangyz@bnu.edu.cn

Yue Wang 王月:
Shenzhen Polytechnic University, Shenzhen.

Rong Wei 魏茸:
Anhui Normal University, Wuhu.
E-mail: 2022403@ahnu.edu.cn

Qiumiao Wen 温秋淼:
Shanghai University, Shanghai.

Zhexin Wen 温哲鑫:
Central South University, Changsha.
E-mail: zhexinwen@gmail.com

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

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

Jiang-Lun Wu 吴奖伦:
Beijing Normal-Hong Kong Baptist University, Zhuhai.
E-mail: jianglunwu@uic.edu.cn

Liming Wu 吴黎明:
I'Université Clermont-Auvergne & Harbin Institute of Technology, Harbin.
E-mail: wuliming@hit.edu.cn

Xian-Yuan Wu 吴宪远:
Capital Normal University
E-mail: wuxy@mail.cnu.edu.cn

Fubao Xi 席福宝:
Beijing Institute of Technology, Beijing.
E-mail: xifb@bit.edu.cn

Miaolin Xiao 肖淼琳:
Chinese Academy of Sciences, Beijing.

Longjie Xie 解龙杰:
Jiangsu Normal University, Xuzhou.
E-mail: longjiexie@jsnu.edu.cn

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

Jie Xu 徐杰:
Henan Normal University, Xinxiang.
E-mail: xujiescu@163.com

Lihu Xu 徐礼虎:
University of Macau, Macau.
E-mail: lihuxu@umac.mo

Jin Xu 徐瑾:
Jiangsu Normal University, Xuzhou.
E-mail: 6020160038@jsnu.edu.cn

Ke Xu 许可:
Shanghai University, Shanghai.

Yao Xue 薛尧:
Beijing Normal University, Beijing.
E-mail: 202331130051@mail.bnu.edu.cn

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

Yanyan Yan 闫艳艳:
Anhui University of Finance and Economics, Bengbu.
E-mail:yanyy@mail.bnu.edu.cn

Dongxia Yang 杨冬霞:
Jiangsu Normal University, Xuzhou.

Fenfen Yang 阳芬芬 :
Shanghai University, Shanghai.
E-mail: yangfenfen@shu.edu.cn

Fan Yang 杨帆:
Tsinghua University, Beijing.
E-mail: fyangmath@mail.tsinghua.edu.cn

Fan Yang 杨帆:
Beijing Normal University, Beijing.
E-mail: fan-yang@bnu.edu.cn

Hao Yang 杨浩:
Hefei University of Technology, Hefei.
E-mail: yanghao@hfut.edu.cn

Hui Yang 杨慧:
Central University for Nationalities, Beijing.
E-mail: yanghui@muc.edu.cn

Qiuchen Yang 杨秋宸:
Shanghai Jiao Tong University, Shanghai.

E-mail: yangqiuchen@sjtu.edu.cn

Ting Yang 杨婷:
Jiangsu Normal University, Xuzhou.
E-mail: yangting@jsnu.edu.cn

Xu Yang 杨叙:
North Minzu University, Yinchuan.
E-mail: xuyang@mail.bnu.edu.cn

Dan Yao 姚丹:
Southern University of Science and Technology, Shenzhen.
E-mail: yaod@sustech.edu.cn

Dong Yao 姚东:
Jiangsu Normal University, Xuzhou.
E-mail: dongyao@jsnu.edu.cn

Jing Yao 姚经:
Soochow University, Suzhou.
E-mail: j.yao@suda.edu.cn

Qian Yu 余迁:
Nanjing University of Aeronautics and Astronautics, Nanjing.
E-mail: qyumath@nuaa.edu.cn

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

Yafei Zhai 翟亚菲:
Beijing Institute of Technology, Beijing.
E-mail: yafeizhai@bit.edu.cn

Beibei Zhang 张贝贝:
Suzhou University of Technology, Suzhou.

Chao Zhang 张超:
Jiangsu Normal University, Xuzhou.
E-mail: chaozhang@jsnu.edu.cn

Chi Zhang 张驰:
Ocean University of China, Qingdao.
E-mail: zhangchi@ouc.edu.cn

Deng Zhang 张登:
Shanghai Jiao Tong University, Shanghai.
E-mail: dzhang@sjtu.edu.cn

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

Junyan Zhang 张君妍:
Beijing Normal University, Beijing.
E-mail: zhangjunyan@mail.bnu.edu.cn

Lixin Zhang 张立新:
Zhejiang Gongshang University, Hangzhou.
E-mail: stazlx@mail.zjgsu.edu.cn

Mei Zhang 张梅:
Beijing Normal University, Beijing.
E-mail: meizhang@bnu.edu.cn

Meijuan Zhang 张美娟:
Central University of Finance and Economics, Beijing.
E-mail: zhangmeijuan@cufe.edu.cn

Mengge Zhang 张梦鸽:
Fujian Normal University, Fuzhou
E-mail: mgzhangmath@163.com

Shaoqin Zhang 张少钦:
Central University of Finance and Economics, Beijing.
E-mail: zhangsq@cufe.edu.cn

Sijia Zhang 张思佳:
Jiangsu Normal University, Xuzhou.

Shuaiqi Zhang 张帅琪:
China University of Mining and Technology, Xuzhou.
E-mail: shuaiqiz@hotmail.com

Tusheng Zhang 张土生:
University of Science and Technology of China, Hefei.
E-mail: tzhang@maths.man.ac.uk

Wenjing Zhang 张文璟:
Beijing Normal University, Beijing.
E-mail: 202231130044@mail.bnu.edu.cn

Wenzhao Zhang 张文钊:
Fuzhou University, Fuzhou.
E-mail: zhangwenzhao1987@163.com

Xiaolong Zhang 张晓龙:
Anhui Normal University, Wuhu.
E-mail: zhangxl.math@ahnu.edu.cn

Yuhui Zhang 张余辉:
Beijing Normal University, Beijing.
E-mail: zhangyh@bnu.edu.cn

Zhenzhong Zhang 张振中:
Donghua University, Shanghai.
E-mail:zzzhong@dhu.edu.cn

Zuozheng Zhang 张作政:
Beijing Institute of Technology, Beijing.
E-mail: zuozhengzhang@mail.bnu.edu.cn

Jiayi Zhao 赵佳怡:

Jiangsu Normal University, Xuzhou.

Pan Zhao 赵盼:
Beijing Union University, Beijing.
E-mail: hebeipanpan@mail.bnu.edu.cn

Peng Zhao 赵鹏:
Jiangsu Normal University, Xuzhou.
E-mail: zhaop@jsnu.edu.cn

Xiaoyu Zhao 赵晓玉:
Tianjin University, Tianjin.

Yi Zhao 赵奕:
Tianjin University, Tianjin.
E-mail: zhaoyibnu@mail.bnu.edu.cn

Zuyi Zhao 赵祖逸:
Beijing Normal University, Beijing.
E-mail: yczhaozy@126.com

Yuhang Zhen 甄钰航:
Zhejiang University of Water Resources and Electric Power, Hangzhou.
E-mail: 18736026345@164.com

Jiayu Zheng 郑家愉:
Shenzhen MSU-BIT University, Shenzhen.
E-mail: jyzheng@smbu.edu.cn

Xiangqi Zheng 郑祥琪:
East China University of Science and Technology, Shanghai.
E-mail: Zhengxq@ecust.edu.cn

Guangshuo Zhou 周广硕:
Sichuan University, Sichuan.
E-mail: zhgsh3363@163.com

Lingzi Zhou 周泠孜:
Xi'an Jiaotong-Liverpool University, Suzhou.
E-mail: Lingzi.Zhou18@student.xjtlu.edu.cn

Qin Zhou 周勤:
Jiangsu Normal University, Xuzhou.
E-mail: graceqinzhou@jsnu.edu.cn

Xiaowen Zhou 周晓文:
Concordia University, Canada.
E-mail: xiaowen.zhou@concordia.ca

Youzhou Zhou 周友洲:
Xi'an Jiaotong-Liverpool University, Suzhou.

Baoxuan Zhu 祝宝宣:
Jiangsu Normal University, Xuzhou.
E-mail: bxzhu@jsnu.edu.cn

Dongjin Zhu 祝东进:
Anhui Normal University, Wuhu.

Fengwu Zhu 朱凤梧:
Wuhan University, Wuhan.
E-mail: fwzhu_math@whu.edu.cn

Jiexiang Zhu 朱洁祥:
Shanghai Normal University, Shanghai.

Shuo Zhu 朱硕:
Beijing Normal University, Beijing.
E-mail: zhushuo@mail.bnu.edu.cn

Yaping Zhu 朱雅萍:
Peking University, Beijing.
E-mail: zhuyp@mail.bnu.edu.cn