The 11th Workshop on Markov Processes and Related Topics

June 27-30, 2015

Academic Activity Center, Minhang Campus

Shanghai Jiao Tong University

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	June 27	**June 28**	**June 29**	**June 30**
Chairman	**D. Han**	**Y. Q. Zhao**	**F. Q. Gao**	**F. Y. Wang**
08:30-08:55	Opening and take picture	R. M. Song	W. A. Zheng	V. Vatutin
08:00-09:20	G. Yin	L. T. Yan	J. L. Wu	Q. X. Zhu
09:20-09:45	J. Xiong	Q. S. Liu	T. F. Jiang	Y. Y. Liu
09:45-10:10	F. Y. Wang	Xin Chen	Y. Z. Hu	X. X. Chen
10:10-10:30	Tea break	Tea break	Tea break	Tea break
10:30-10:55	Z. Dong	H. J. Zhang	T. S. Zhang	C. L. Wang
10:55-11:20	Z. C. Hu	A. H. Xia	C. Zhu	C. H. Ma
11:20-11:45	H. M. Wang	J. Wang	B. Wu	H. Z. Zhao
Chairman	**C. R. Hwang**	**L. T. Yan**	**R. M. Song**	
14:30-14:55	D. Nualard	Y. M. Xiao	Y. Q. Zhao	
14:55-15:20	Z. Q. Chen	C. G. Yuan	F. Q. Gao	
15:20-15:45	X. D. Li	J. P. Li	J. W. Chen	
15:45-16:10	X. C. Zhang	Y. Q. Li	S. J. Wu	
16:10-16:30	Tea break	Tea break	Tea break	
16:30-16:55	Q. M. Shao	Xia Chen	S. Feng	
16:55-17:20	G. Y. Chen	T. Uemura	X. P. Guo	
17:20-17:45	F. B. Xi	H. He	J. H. Bao	

June 27

Chairman: Dong Han

08:30-08:55 Opening and take pictures

08:55-09:20 Geroge Yin (Wayne State University, USA)

Limit Cycles of Stochastic Multi-scale Systems

09:20-09:45 Jie Xiong (University of Macau, Macau)

Some uniqueness problems from population models

09:45-10:10 Feng-Yu Wang (Beijing Normal University, Beijing)

SDEs in Hilbert Space with Multiplicative Noise and Log-Holder Drift

10:10-10:30 Tea break

10:30-10:55 Zhao Dong (Chinese Academy of Sciences, Beijing)

Exponential Convergence for 3D Stochastic Primitive Equations of the Large Scale Ocean

10:55-11:20 Ze-Chun Hu (Nanjing University, Nanjing)

Hunt's Hypothesis (H) for the Sum of Two Independent Lévy Processes

11:20-11:45 Hua-Ming Wang (Anhui Normal University, Wuhu)

Law of large numbers for random walk with unbounded jumps in random environment

Chairman: Chii-Ruey Hwang

14:30-14:55 David Nualart (The University of Kansas, USA)

Numerical approximation schemes for fractional diffusions

14:55-15:20 Zhen-Qing Chen (University of Washington, USA)

Obliquely reflected Brownian motion

15:20-15:45 Xiangdong LI (Chinese Academy of Sciences, Beijing)

Optimal transportation and W-entropy formula on Riemannian manifolds

15:45-16:10 Xicheng Zhang (Wuhan University, Wuhan)

Degenerate SDE with Hölder-Dini Drift and Non-Lipschitz Noise Coefficient

16:10-16:30 Tea break

16:30-16:55 Qi-Man Shao (The Chinese University of Hong Kong, HK)

The Riemann Hypothesis and Stein's method

16:55-17:20 Guan-Yu Chen (National Chiao Tung University, Hsinchu)

Computing the cutoff time of birth and death chains

17:20-17:45 Fubo Xi (Beijing Institute of Technology, Beijing)

Switching jump-diffusions processes whose discrete components have infinite countable states

June 28

Chairman: Q. Yiqiang Zhao

08:30-08:55 Renming Song (University of Illinois, USA)

Oscillation reduction for harmonic functions of subordinate Brownian motions

08:55-09:20 Litan Yan (Donghua University, Shanghai)

A class of fractional SPDEs with fractional noise

09:20-09:45 Quansheng Liu (Université de Bretagne-Sud, France)

Exact convergence rates in central limit theorems for a branching random walk

09:45-10:10 Xin Chen (Shanghai Jiao Tong University, Shanghai)

Euler-Poincaré equations on semidirect products for stochastic Lagrangians

10:10-10:30 Tea break

10:30-10:55 Hanjun Zhang (Xiangtan University, Xiangtan)

The existence of Quasi-stationary distribution for birth-death processes with killing

10:55-11:20 Aihua Xia (The University of Melbourne, Australia)

When do wireless network signals appear Poisson?

11:20-11:45 Jian Wang (Fujian Normal University, Fuzhou)

Stability of parabolic Harnack inequalities for jump processes on metric measure spaces

Chairman: Litan Yan

14:30-14:55 Yimin Xiao (Michigan State University, USA)

Discrete Fractal Dimensions and Large Scale Multifractals

14:55-15:20 Chenggui Yuan (Swansea University, UK)

Hypercontractivity for Functional Stochastic Partial Differential Equations

15:20-15:45 Junping Li (Central South University, Changsha)

n-Type branching processes with immigration

15:45-16:10 Yuqiang Li (East China Normal University, Shanghai)

Occupation limits of site-dependent branching particle systems

16:10-16:30 Tea break

16:30-16:55 Xia Chen (University of Tennessee, USA / Jilin University, Changchun)

Free energy in a mean field of Brownian particles

16:55-17:20 Toshihiro Uemura (Kansai University, Japan)

On the Mosco Convergence of symmetric jump type Dirichlet forms

17:20-17:45 Hui He (Beijing Normal University, Beijing)

On large deviation rates for Galton-Watson processes

June 29

Chairman: Fuqing Gao

08:30-08:55 Weian Zheng (East China Normal University, Shanghai)

Statistical Arbitrage and Option Prices

08:55-09:20 Jiang-Lun Wu (Swansea University, UK)

Characterising the path-independence of Girsanov transformation for SDEs with jumps

09:20-09:45 Tiefeng Jiang (University of Minnesota, USA)

Statistical Properties of Eigenvalues of Laplace-Beltrami Operators

09:45-10:10 Yaozhong Hu (University of Kansas, USA)

Stochastic differential equation for Brox diffusion

10:10-10:30 Tea break

10:30-10:55 Tusheng Zhang (University of Manchester, UK and University of Science and Technology of China, Hefei)

Approximations of Stochastic Partial Differential Equations

10:55-11:20 Chao Zhu (University of Wisconsin-Milwaukee, USA)

Optimal Inventory Control with Path-Dependent Cost Criteria

11:20-11:45 Bo Wu (Fudan University, Shanghai)

The Logarithmic Sobolev inequality on loop space over the hyperbolic space

Chairman: Renming Song

14:30-14:55 Yiqiang Q. Zhao (Carleton University, Canada)

Exploration of BVP — Explicit Solutions for Two-Dimensional Queuing Systems

14:55-15:20 Fuqing Gao (Wuhan University, Wuhan)

Long time asymptotics of additive functionals with quadric growth of Markov processes

15:20-15:45 Jinwen Chen (Tsinghua University, Beijing)

Conditional Limits of Markov processes

15:45-16:10 Sheng-Jhih Wu (Soochow University, Suzhou)

Limit theorems for the estimation of L^1 integrals using the Brownian motion

16:10-16:30 Tea break

16:30-16:55 Shui Feng (McMaster University, Canada)

Asymptotic Behaviour of Sample Diversity

16:55-17:20 Xianping Guo (Sun Yat-sen University, Guangzhou)

First passage Markov decision processes with constraints and varying discount factors

17:20-17:45 Jianhai Bao (Central South University, Changsha)

Numerical Approximation of Stationary Distributions for Stochastic Partial Differential Equations

June 30

Chairman: Feng-Yu Wang

08:30-08:55 Vladimir Vatutin (Steklov Mathematical Institute, Russia)

The family tree of a reduced branching process

08:55-09:20 Quanxin Zhu (Nanjing Normal University, Nanjing)

Finite-time stabilization of high-order stochastic nonlinear systems

09:20-09:45 Yuanyuan Liu (Central South University, Changsha)

Wavelet transform for quasi-birth-death processes with a continuous phase set

09:45-10:10 Xinxing Chen (Shanghai Jiao Tong University, Shanghai)

Gaussian bounds on locally irregular graphs

10:10-10:30 Tea break

10:30-10:55 Chia-Li Wang (Dong Hwa University, Hualien, Taiwan)

Social Optimization for Observable Queues of Heterogeneous Customers

10:55-11:20 Chunhua Ma (Nankai University, Tianjin)

The limiting distributions of affine processes

11:20-11:45 Huaizhong Zhao (Loughborough University, UK)

Random Periodic Processes, Periodic Measures and Ergodicity

NUMERICAL APPROXIMATION OF STATIONARY DISTRIBUTIONS FOR STOCHASTIC PARTIAL DIFFERENTIAL EQUATIONS

Jianhai BAO, *Central South University, P.R.China*, E-mail: jianhaibao13@gmail.com
Chenggui Yuan *Swansea University, UK*, E-mail: C.Yuan@swansea.ac.uk

Key words: stochastic partial differential equation; mild solution; stationary distribution; exponential integrator scheme; numerical approximation

Mathematical Subject Classification: 60H15; 65C30; 35K90

Abstract: In this paper, we discuss an exponential integrator scheme, based on spatial discretization and time discretization, for a class of stochastic partial differential equations. We show that the scheme has a unique stationary distribution whenever the stepsize is sufficiently small, and that the weak limit of the stationary distribution of the scheme as the stepsize tends to zero is in fact the stationary distribution of the corresponding stochastic partial differential equations.

Reference

[1] Jianhai Bao, Chenggui Yuan (2014). Numerical Approximation of Stationary Distributions for Stochastic Partial Differential Equations, *J. Appl. Probab.*, **No. 51**, 858–873.

COMPUTING THE CUTOFF TIME OF BIRTH AND DEATH CHAINS

Guan-Yu CHEN *National Chiao Tung University, Hsinchu, Taiwan*,
E-mail: gychen@math.nctu.edu.tw
Laurent Saloff-Coste *Cornell University, USA*, E-mail:lsc@math.cornell.edu

Key words: Birth and death chains, Cutoff phenomenon, Mixing times

Mathematical Subject Classification: 60J10, 60J27

Abstract: Earlier work by Diaconis and Saloff-Coste gives a spectral criterion for a maximum separation cutoff to occur for birth and death chains. Ding, Lubetzky and Peres gave a related criterion for a maximum total variation cutoff to occur in the same setting. Here, we provide complementary results which allow us to compute the cutoff times and windows in a variety of examples.. . .

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CONDITIONAL LIMITS OF MARKOV PROCESSES

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

Abstract: In this talk, limiting distribution and limiting process of a Markov process conditioned on certain rare events will be discussed. Some large deviation consideration are involved.

FREE ENERGY IN A MEAN FIELD OF BROWNIAN PARTICLES

Xia CHEN *University of Tennessee, USA*, E-mail: xchen@math.utk.edu
T.V. Phan *University of Tennessee*

Key words: mean field, Brownian motion, parabolic Anderson model, Donsker-Varadhan large deviations, ground state energy, Hartrees theory, many body problem

Mathematical Subject Classification: 60J65, 60K37,60K40, 60G55, 60F10, 81V70 ...

Abstract: We compute the limit of the free energy of the mean field generated by the independent Brownian particles interacting through the non-negative definite function $\gamma(\cdot)$. Our main theorem is relevant to the high moment asymptotics for the parabolic Anderson models with Gaussian noise that is white in time, white or colored in space. Our approach makes a novel connection to the celebrated Donsker-Varadhans large deviation principle for the i.i.d. random variables in infinite dimensional spaces. As an application of our main theorem, we provide a probabilistic treatment to the Hartrees theory on the asymptotics for the ground state energy of bosonic quantum system.

EULER-POINCARÉ EQUATIONS ON SEMIDIRECT PRODUCTS FOR STOCHASTIC LAGRANGIANS

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

Abstract: We derive Euler-Poincaré equations for stochastic processes defined on semidirect product Lie algebras. These equations are a generalization of the classical Euler-Poincaré equations and allow for dissipation. We discuss in detail the situation when the group in the general theory is a group of diffeomorphism and derive, as an application, a MHD system for viscous compressible uids. This talk is based on a joint work with Ana Bela Cruzeiro and Tudor Ratiu.

GAUSSIAN BOUNDS ON LOCALLY IRREGULAR GRAPHS

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

Abstract: A well known theorem of Delmotte is that Gaussian bounds, parabolic Harnack inequality, and the combination of volume doubling and Poincaré inequality are equivalent for

graphs. In this talk, we consider graphs for which these conditions hold, but only for sufficiently large balls, and show a similar equivalence. We also show more precise sufficient conditions on the range of balls for which good behaviour is required in order to obtain heat kernel bounds in a fixed ball.

OBLIQUELY REFLECTED BROWNIAN MOTION

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

Abstract:

In this talk, I will present a construction of obliquely reflected Brownian motions in all bounded simply connected planar domains, including non-smooth domains. Conformal mappings are the main technical tool. The family of all obliquely reflected Brownian motions in a given domain is parametrized in two different ways, either by the field of angles of oblique reflection on the boundary or by the stationary distribution and the rate of rotation of the process about a reference point in the domain.

Based on joint work with Krzysztof Burdzy, Donald Marshall and Kavita Ramanan.

EXPONENTIAL CONVERGENCE FOR 3D STOCHASTIC PRIMITIVE EQUATIONS OF THE LARGE SCALE OCEAN

Dong ZHAO *Chinese Academy of Sciences, PRC*, E-mail: dzhao@amt.ac.cn

Abstract: In this paper, we consider the ergodicity for the three-dimensional stochastic primitive equations of the large scale oceanic motion. We proved that if the noise is at the same time sufficiently smooth and non-degenerate, then the weak solutions converge exponentially fast to equilibrium. Moreover, uniqueness of invariant measures are stated clearly and the coupling method introduced by Odasso plays a key role.

ASYMPTOTIC BEHAVIOUR OF SAMPLE DIVERSITY

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

Abstract: Consider a population of individuals of various types. The number of different types appearing in a sample is called the sample diversity. In this talk we focus on several models and discuss the corresponding limit theorems.

LONG TIME ASYMPTOTICS OF ADDITIVE FUNCTIONALS WITH QUADRIC GROWTH OF MARKOV PROCESSES

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

Key words: ergodic HJB equation, hypercontractivity, long-time asymptotics, moderate deviations, perturbation theory, viscosity solution

Mathematical Subject Classification: 60F10, 60J55, 47A55, 49L25

Abstract: Under hypercontractivity and L_p-integrability of transition density for some $p > 1$, we use the perturbation theory of linear operators to obtain the long time asymptotics and the moderate deviation principle for additive functionals with quadric growth of Markov processes. Applying the results to stochastic differential equations with multiplicative noise, we give a solution in viscosity sense for a class of ergodic Hamilton-Jacobi-Bellman equation with nonsmooth and quadric growth cost and establish the moderate deviation principle for additive functionals with quadric growth of the diffusion processes under some explicit conditions on the coefficients.

References

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FIRST PASSAGE MARKOV DECISION PROCESSES WITH CONSTRAINTS AND VARYING DISCOUNT FACTORS

Xianping GUO *Sun Yat-sen University, PRC*, E-mail: mcsgxp@mail.sysu.edu.cn
Xiao Wu *Yat-sen University, PRC*
Xiaolong Zou *Yat-sen University, PRC*

Abstract: This talk concerns with the constrained optimality problem (COP) of first passage discrete-time Markov decision processes with multi-constraints, state-dependent discount factors, and possibly unbounded costs. By means of the properties of a so-called occupation measure of a policy, we show that the constrained optimality problem is equivalent to an (infinite-dimensional) linear programming on the set of occupation measures, and thus prove the existence of an optimal policy under suitable conditions. Furthermore, using the equivalence between the constrained optimality problem and the linear programming, we obtain an exact form of an optimal policy for the case of finite states and actions. Finally, as an example, a controlled queueing system is given to illustrate our results.

ON LARGE DEVIATION RATES FOR GALTON-WATSON PROCESSES

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

KEY WORDS: Galton-Watson process, domain of attraction, stable distribution, slowly varying function, large deviation, Lotka-Nagaev estimator, martingale limit, branching random walk

MATHEMATICAL SUBJECT CLASSIFICATION: 60J80, 60F10

Abstract: Let $\{Z_n\}$ be a super-critical Galton-Watson process with $m = E[Z_1]$ and $Z_0 = 1$. We assume that we are in Schröder case with $EZ_1 \log Z_1 < \infty$. When Z_1 is sub-exponentially distributed, we obtain the convergence rates of

$$P\left(\left|\frac{Z_{n+1}}{Z_n} - m\right| \geq \epsilon\right), \quad P\left(\left|\frac{Z_n}{m^n} - W\right| \geq \epsilon\right),$$

as $n \to \infty$, where $\epsilon > 0$ and W is the martingale limit of $\frac{Z_n}{m^n}$. As by products, we further study the convergence rates of branching random walks.

STOCHASTIC DIFFERENTIAL EQUATION FOR BROX DIFFUSION

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

Abstract: This talk some results on the weak and strong solutions to the stochastic differential equation $dX(t) = -\frac{1}{2}\dot{W}(X(t))dt + d\mathcal{B}(t)$, where $(\mathcal{B}(t), t \geq 0)$ is a standard Brownian motion and $W(x)$ is a two sided Brownian motion, independent of $\mathcal{B}$. It is shown that the Itô-McKean representation associated with any Brownian motion (independent of W) is a weak solution to the above equation. It is also shown that there exists a unique strong solution to the equation. Itô calculus for the solution is developed. For dealing with the singularity of drift term $\int_0^T \dot{W}(X(t))dt$, the main idea is to use the concept of local time together with the polygonal approximation W_π. Some new results on the local time of Brownian motion needed in our proof are established.

This is a joint work with Khoa Le and Leonid Mytnik.

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

Ze-Chun HU *Nanjing University, China*, E-mail: huzc@nju.edu.cn
Wei Sun *Concordia University, Canada*

KEY WORDS: Hunt's hypothesis (H), Lévy process

MATHEMATICAL SUBJECT CLASSIFICATION: 60J45; 60G51

Abstract: Up to now, we have some good sufficient conditions (such as Kanda-Forst condition, Rao's condition and the extended Kanda-Forst-Rao condition etc.) for a Lévy process to satisfy Hunt's hypothesis (H), but in order to completely understand (H) for Lévy processes, even in one dimensional case, it seems that we should consider (H) for the sum of two independent Lévy processes. In this paper, we explore this problem and obtain some meaningful results. In addition, we obtain one result on (H) for 1-dimensional Lévy process, which extends one of Kesten's, and give some capacity inequalities which have their own interests.

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STATISTICAL PROPERTIES OF EIGENVALUES OF LAPLACE-BELTRAMI OPERATORS

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

Abstract: We study the eigenvalues of a Laplace-Beltrami operator defined on the set of the symmetric polynomials, where the eigenvalues are expressed in terms of partitions of integers. By assigning partitions with the uniform measure, the restricted uniform measure, the Plancherel measure, or the restricted Jack measure, we prove that the global distributions of the eigenvalues are asymptotically the Gumbel distribution, a new distribution F, the Tracy-Widom distribution and the Gamma distribution, respectively. An explicit representation of F is obtained by a function of independent random variables. We also derive an independent result on random partitions itself: a law of large numbers for the restricted uniform measure.

Joint work with Ke Wang.

OPTIMAL TRANSPORTATION AND W-ENTROPY FORMULA ON RIEMANNIAN MANIFOLDS

Xiangdong LI *Academy of Mathematics and Systems Science, Chinese Academy of Sciences, China*
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Songzi Li *Fudan University, China, and Université Paul Sabatier, France*
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Key words: W-entropy, heat equation, the Witten Laplacian, the optimal transportation problem, geodesic flow, deformation of geometric flows, Wasserstein space

Mathematical Subject Classification: 51G62

Abstract: In this talk, we will first review Perelman's W-entropy formula for Ricci flow and the W-entropy formula for the heat equation of the Witten Laplacian on complete Riemannian manifolds. Then we will introduce the W-entropy and prove the W-entropy formula for the geodesic flow on the Wasserstein space (i.e., the optimal transport problem) over Riemannian manifolds. To explain the similarity between these two W-entropy formulas, we will introduce a deformation of geometric flows on the Wasserstein space, which interpolates the geodesic flow on the Wasserstein space and the heat equation of the Witten Laplacian on the underlying

manifold. Finally, we will prove the W-entropy type formula for each geometric flow in the above deformation on the Wasserstein space.

References

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OCCUPATION LIMITS OF SITE-DEPENDENT BRANCHING PARTICLE SYSTEMS

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

KEY WORDS: Occupation time process, Fluctuation limit, Critical dimension, Spatial branching process

MATHEMATICAL SUBJECT CLASSIFICATION: 60F17; 60J80

Abstract: In this talk, we will report some results on the functional limits of occupation time processes of a kind of space-inhomogeneous (d, α, β)-branching particle systems whose branching laws depend on the location of particles and present some discussion on the relation between the critical dimensions and the site-dependent branching laws.

References

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EXACT CONVERGENCE RATES IN CENTRAL LIMIT THEOREMS FOR A BRANCHING RANDOM WALK

Zhiqiang Gao *Beijing Normal University*
Quansheng LIU *Université de Bretagne-Sud, France*, E-mail: quansheng.liu@univ-ubs.fr

Key words: Branching random walk, random environment, central limit theorems, convergence rate.

Mathematical Subject Classification: Preliminary 60K37, 60J10, 60F05, 60J80.

Abstract: Chen [Ann. Appl. Probab. 11 (2001), 1242–1262] derived exact convergence rates in a central limit theorem and a local limit theorem for a supercritical branching Wiener process. We extend Chen's results to a branching random walk under weaker moment conditions. For the branching Wiener process, our results sharpen Chen's by relaxing the second moment condition used by Chen to a moment condition of the form $EX|\ln X|^{1+\lambda} < \infty$. In the rate functions that we find for a branching random walk, we figure out some new terms which didn't appear in Chen's work. The results are established in the more general framework, i.e. for a branching random walk with a random environment in time. The lack of the second moment condition for the offspring distribution and the fact that the exponential moment does not exist necessarily for the displacements make the proof delicate; the difficulty is overcome by a careful analysis of martingale convergence using a truncating argument. The analysis is also significantly more awkward due to the appearance of the random environment.

References

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WAVELET TRANSFORM FOR QUASI-BIRTH-DEATH PROCESSES WITH A CONTINUOUS PHASE SET

Shuxia Jiang *Central South University, China*
Guy Latouche *Université Libre de Bruxelles, Belgium*,
Yuanyuan LIU *Central South University, China*, E-mail: liuyy@csu.edu.cn

Abstract: We consider the computational questions which arise when analyzing quasi-birth-death processes with a continuous phase set. We develop a framework based on the wavelet transform and we propose a numerical algorithm for computing the steady-state probabilities based on the fast orthogonal wavelet transform. We conclude with a few examples to illustrate the effectiveness of our numerical algorithm.

References

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THE LIMITING DISTRIBUTIONS OF AFFINE PROCESSES

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Abstract: The affine Markov processes introduced by Duffie (2003) have been used widely in the financial world. In this talk, we study the existence of the limiting distributions and ergodicity for the class of processes. Furthermore, a characterization of the limiting distribution can be given in the sense of skew convolution semigroup introduced by Li (2002).

NUMERICAL APPROXIMATION SCHEMES FOR FRACTIONAL DIFFUSIONS

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Key words: Fractional Brownian motion, stochastic differential equations, Euler scheme, Malliavin calculus, fourth moment theorem

Mathematical Subject Classification: 60H07, 26A33, 60H35

Abstract: For a stochastic differential equation driven by a fractional Brownian motion with Hurst parameter $H > \frac{1}{2}$ it is known that the existing Euler scheme has the rate of convergence n^{1-2H} and this rate is sharp (see [1,3]). The purpose of this talk is to present a new *modified Euler scheme*. The rate of convergence of this scheme with step size $1/n$ turns out to be γ_n^{-1}, where $\gamma_n = n^{2H-\frac{1}{2}}$ when $H < \frac{3}{4}$, $\gamma_n = n/\sqrt{\log n}$ when $H = \frac{3}{4}$ and $\gamma_n = n$ if $H > \frac{3}{4}$

We will also discuss the asymptotic behavior of the fluctuations of the error. More precisely, if $\{X_t, 0 \le t \le T\}$ is the solution of a stochastic differential equation driven by a fractional Brownian motion and if $\{X_t^n, 0 \le t \le T\}$ is its approximation obtained by the modified Euler scheme, then $\gamma_n(X^n - X)$ converges stably to the solution of a linear stochastic differential equation driven by a matrix-valued Brownian motion, when $H \in (\frac{1}{2}, \frac{3}{4}]$. In the case $H > \frac{3}{4}$, $n(X_t^n - X_t)$ converges in L^p, and the limiting process satisfies a linear stochastic differential equation driven by a matrix-valued Rosenblatt process. These results have been obtained applying techniques of Malliavin calculus and the fourth moment theorem. We will also discuss the corresponding weak approximation results.

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THE RIEMANN HYPOTHESIS AND STEIN'S METHOD

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Abstract: In this talk we review recent developments of non-normal approximation by Stein's method and their possible connections to the Riemann Hypothesis. In particularly, for a given sequence of Ising models, we give a concrete approach to identify the limiting distribution. On the other hand, for a given limiting distribution called Ψ, if one can find a sequence of Ising models so that the limiting distribution is Ψ, then the Riemann Hypothesis holds. The problem can be reduced to calculate conditional expectations and conditional variances.

OSCILLATION REDUCTION FOR HARMONIC FUNCTIONS OF SUBORDINATE BROWNIAN MOTIONS

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KEY WORDS: Subordinate Brownian motion, harmonic function, Poisson kernel, Martin kernel

MATHEMATICAL SUBJECT CLASSIFICATION: 60J50, 60J45, 60J75

Abstract: In this talk, I will present a recent result on oscillation reduction of quotients of positive harmonic functions of subordinate Brownian motions. I will also give some application of this result to Martin kernels of subordinate Brownian motions.

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ON THE MOSCO CONVERGENCE OF SYMMETRIC JUMP TYPE DIRICHLET FORMS

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Abstract: In the talk, I will show Mosco's convergence of symmetric jump type Dirichlet forms on $L^2(R^d)$ and the limit is the Dirichlet form corresponding to a symmetric diffusion process on R^d under a slighly weaker conditions on the Levy kernels. The conditions are given by impoing the L^1-local convergence of the Lévy kernels. We stress that not just global path properties, but also the path types of the corresponding Markov processes are not presereved under the Mosco convergences (see also [4]).

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THE FAMILY TREE OF A REDUCED BRANCHING PROCESS

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KEY WORDS: multitype branching processes, functional limit theorems, family trees

MATHEMATICAL SUBJECT CLASSIFICATION: 60J80

Abstract: A critical Galton-Watson branching process $\mathbf{Z}(n) = (Z_1(n), ..., Z_N(n))$ with N types of particles labelled $1, 2, ..., N$ is considered in which a type i parent may produce individuals of types $j \geq i$ only. This model may be viewed as a stochastic model for the sizes of a geographically structured population occupying N islands, the location of a particle being considered as its type. The newborn particles of island $i < N$ either stay at the same island or migrate, just after their birth to the islands $i+1, i+2, ..., N$. Particles of island N do not migrate.

Let $Z_i(m, n)$ be the number of type i particles existing in the process at moment $m < n$ and having nonempty number of descendants at moment n. The process $\{\mathbf{Z}(m, n) = (Z_1(m, n), ..., Z_N(m, n)), 0 \leq m < n\}$ can be thought of as the family tree relating the individuals alive at time n. We show that if $\mathbf{Z}(\cdot)$ is a critical process and the variance of the total number of direct descendants of particles of all its types is finite then the finite-dimensional distributions of the conditional process

$$\left\{\mathbf{Z}\left(n^t \log n, n\right), 0 \leq t < 1 | \mathbf{Z}(n) \neq \mathbf{0}\right\}$$

converge, as $n \to \infty$ to finite-dimensional distributions of an $N-$ dimensional inhomogeneous branching process $\{\rho(t), 0 \leq t < 1\}$ with step-wise trajectories and which, at any fixed moment consists of particles of a single type only. The phase transition from type i to type $i+1$ happens at moment $t = 2^{-(N-i)}$. This gives a macroscopic view on the structure of the family tree of the process.

On the other hand, for $i \leq N-1$ the conditional process

$$\left\{\mathbf{Z}\left(\left(y + \frac{1}{\log n}\right) n^{1/2^{(N-i)}}, n\right), 0 \leq y < \infty | \mathbf{Z}(n) \neq \mathbf{0}\right\}$$

converges in Skorokhod topology, as $n \to \infty$ to a homogeneous branching process $\{\mu_i(y), 0 \leq y < \infty\}$ which is initiated at moment $y = 0$ by a random number of type i particles with probability generating function

$$f_i(s) = 1 - (1-s)^{1/2^{i-1}}.$$

Each type i particle has an exponential life-length distribution and dying produces either two particles of type i or one particle of type $i+1$ (each option with probability $1/2$). Particles of type $i+1$ in this process are immortal and produce no offspring. This gives a microscopic view on the structure of the family tree of the process.

Finally, the conditional process

$$\left\{\mathbf{Z}\left(\left(x + \frac{1}{\log n}\right) n, n\right), 0 \leq x < 1 | \mathbf{Z}(n) \neq \mathbf{0}\right\}$$

converges in Skorokhod topology, as $n \to \infty$ to an inhomogeneous branching process $\{\mu_N(x), 0 \leq x < 1\}$ which is initiated at moment $x = 0$ by a random number of type N particles with probability generating function

$$f_N(s) = 1 - (1 - s)^{1/2^{N-1}}.$$

The life-length of each initial type N particle is uniformly distributed on $[0, 1]$. Dying such a particle produces exactly two children of type N and nothing else. If the death moment of a parent particle is $x \in (0, 1)$ then the life length of each of its offspring has the uniform distribution on the interval $[x, 1]$ (independently of the behavior of other particles and the prehistory of the process). Dying each particle of the process produces exactly two individuals of type N and so on... .

Acknowledgment. This work was supported by the grant RFBR 14-01-00318.

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SOCIAL OPTIMIZATION FOR OBSERVABLE QUEUES OF HETEROGENEOUS CUSTOMERS

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Abstract: Suppose heterogeneous customers arrive at an observable queueing system with different preference of service. A system administrator controls the queue length in pursuit of maximal social profit. As it has been illustrated for various models, the socially optimal policy which is of practical importance often requires a tedious and ad hoc analysis due to the external effects. We will apply a recently proposed approach that is simple and general to study the optimal admission policy. The main idea of this approach is to consider a special rule that admits an extra customer who is served only by the surplus capacity and bears all the increased waiting time and thus incurs no external cost. The approach applies in principle to queues with exponential service. Consequently, a marginal analysis based on this rule will explore the properties of the optimal social policy and lead to a general procedure of deriving the optimal threshold. An investigation into whether the class dominance occurs and a comparison to self-decision are also reported in this study.

SSDES IN HILBERT SPACE WITH MULTIPLICATIVE NOISE AND LOG-HOLDER DRIFT

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Abstract: Consider the stochastic evolution equation in a separable Hilbert space $\mathbf{H}$ with a nice multiplicative noise and a locally log-Holder continuous drift $b : [0, \infty) \times \mathbf{H} \to \mathbf{H}$. Under a reasonable condition ensuring the non-explosion of the solution, the strong Feller property of the associated Markov semigroup is proved. Gradient estimates and log-Harnack inequalities are derived for the associated semigroup under certain global conditions, which are new even in finite-dimensions.

LAW OF LARGE NUMBERS FOR RANDOM WALK WITH UNBOUNDED JUMPS IN RANDOM ENVIRONMENT

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KEY WORDS: Random walk; random environment; invariant measure; unbounded jumps.

MATHEMATICAL SUBJECT CLASSIFICATION: 60k37; 60F15.

Abstract: In this talk, we introduce some recent progresses on random walk with *unbounded jumps* in random environment. The environment is stationary and ergodic, uniformly elliptic and decays *polynomially* with speed $Dj^{-(3+\varepsilon_0)}$ for some small $\varepsilon_0 > 0$ and proper $D > 0$. We prove a law of large numbers with positive speed under the condition that the annealed mean of the hitting time of the positive half lattice is finite. This talk is based on our recent work[**?**].

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STABILITY OF PARABOLIC HARNACK INEQUALITIES FOR JUMP PROCESSES ON METRIC MEASURE SPACES

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Jian WANG *Fujian Normal University, China*, E-mail: jianwang@fjnu.edu.cn

Abstract: We consider mixed-type jump processes on metric measure spaces and prove the stability of parabolic Harnack inequalities. We establish their stable equivalent characterizations in terms of the jump kernels, modifications of cut-off Sobolev inequalities, and the Poincaré inequalities. In particular, we prove the stability of parabolic Harnack inequalities for α-stable-like processes even with $\alpha \geq 2$ when the underlying spaces have walk dimensions larger than 2, which has been one of the major open problems in this area. This is a joint work with Z.-Q. Chen (Seattle) and T. Kumagai (Kyoto).

THE LOGARITHMIC SOBOLEV INEQUALITY ON LOOP SPACE OVER THE HYPERBOLIC SPACE

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KEY WORDS: Logarithmic Sobolev inequality, Loop space, Hyperbolic space

MATHEMATICAL SUBJECT CLASSIFICATION: 60H07

Abstract: In this talk, we prove a log-Sobolev inequality with explicit potential for the gradient on a based loop space over the hyperbolic space $H^n(c)$. And the potential function relies only

the curvature c and the dimension n of the manifold. In particular, the case $c = 0$, we obtain the standard Log-Sobolev inequality on loop space.

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CHARACTERISING THE PATH-INDEPENDENCE OF GIRSANOV TRANSFORMATION FOR SDES WITH JUMPS

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KEY WORDS: non-Lipschnitz stochastic differential equations with jumps, the Girsanov transformation, semi-linear partial integro-differential equations of parabolic type, stochastic evolution equations with jumps in Hilbert spaces.

MATHEMATICAL SUBJECT CLASSIFICATION: 60H10; 60H15; 35Q53

Abstract: In this talk, I will present our recent progress on characterising the path-independence of the Girsanov transformation for SDEs with jumps. Extension to stochastic evolution equations with jumps in Hilbert spaces will be discussed briefly. The talk is based on two joint papers with Huijie Qiao.

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LIMIT THEOREMS FOR THE ESTIMATION OF L^1 INTEGRALS USING THE BROWNIAN MOTION

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Raoul Normand *Academia Sinica, Taiwan*
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Key words: Brownian motion, local time, point estimate, Ray-Knight theorem, regenerative process

Mathematical Subject Classification: 62F10, 60J65, 60F05

Abstract: In this talk, we will provide a point estimate for integrals on the real line, based on the standard Brownian motion. The consistency of the estimator and limit theorems for the fluctuations will be shown. The proof relies on computing the distribution of the local time of a Brownian motion at a specific stopping time.

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SWITCHING JUMP-DIFFUSIONS PROCESSES WHOSE DISCRETE COMPONENTS HAVE INFINITE COUNTABLE STATES

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Key words: Jump-diffusion, switching, existence, uniqueness, strong Feller property.

Mathematical Subject Classification: 60J25, 60J27, 60J60.

Abstract: This work focuses on a class of switching jump-diffusion processes. First, compared with the most existing results in the literature, in our model, the discrete components are allowed to have infinite countable states (or regimes). The existence and uniqueness of the underlying process are obtained by representing the switching component as a stochastic integral with respect to a Poisson random measure and by using a successive approximation method. Then, some identities of transition probabilities for diffusions, jump diffusions, and a special type of switching jump diffusion are established. Using these identities, the strong Feller property is then proved for a special type switching jump diffusion. Finally, the strong Feller property is obtained for general cases by using the result for the special switching jump diffusion with the Radon-Nikodym derivative.

WHEN DO WIRELESS NETWORK SIGNALS APPEAR POISSON?

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KEY WORDS: Wireless networks, point process, Cox process, Poisson process, coupling.

MATHEMATICAL SUBJECT CLASSIFICATION: Primary 60K30, secondary 60G55, 60F17.

Abstract: We show that the point process of signal strengths from transmitters in a wireless network observed from a fixed position can be well-approximated by an inhomogeneous Poisson or a Cox point processes on the positive real line.

Under appropriate conditions, our results support the use of a spatial Poisson point process for the underlying positioning of transmitters in models of wireless networks, even if in reality the positioning does not appear Poisson. We apply the results to a number of models with popular choices for positioning of transmitters, path loss functions, and distributions of propagation effects. (joint work with P Keeler and N Ross).

DISCRETE FRACTAL DIMENSIONS AND LARGE SCALE MULTIFRACTALS

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KEY WORDS: Macroscopic/large-scale Hausdorff dimension, Brownian motion, Ornstein-Uhlenbeck process, stochastic partial differential equations, multifractality.

MATHEMATICAL SUBJECT CLASSIFICATION: 60H15; 60G15; 35R60; 60K37.

Abstract: Ordinary fractal dimensions such as Hausdorff dimension and packing dimension are useful for analyzing the (microscopic) geometric structures of various thin sets and measures. For studying (macroscopic or global) fractal phenomena of discrete sets, such as percolation clusters, Barlow and Taylor (1989, 1992) introduced the notions of discrete Hausdorff and packing dimensions. These dimensions have been applied to study random walks and random walks in random environment. In this talk we present some recent results on multifractal properties (in terms of discrete fractal dimensions) of random sets associated with Brownian motion, the Ornstein-Uhlenbeck processes and stochastic partial differential equations.

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SOME UNIQUENESS PROBLEMS FROM POPULATION MODELS

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KEY WORDS: Superprocess, interaction, immigration, pathwise uniqueness, Yamada-Watanabe argument.

MATHEMATICAL SUBJECT CLASSIFICATION: Primary 60J68; 60H15; Secondary 60H05.

Abstract: In this talk, we survey some results on uniqueness of solutions for various problems from population models. First, we will study the characterization of the classical SBM by a nonlinear SPDE. Then, we will consider the the uniqueness problem for an SPDE with derivative depending noise terms. Finally, we will study the SBM with interactive immigration. If time permit, we will also mention the case when the underlying spatial motion is of jumps and/or the branching mechanism is of a general form.

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Limit Cycles of Stochastic Multi-scale Systems

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Key words: Stochastic differentia equation, limit cycle
Mathematical Subject Classification: 34C05, 60H10

Abstract: This talk focuses on multi-scale stochastic systems with random switching and diffusion. The multi-scale formulation is highlighted by two small parameters ε and δ. One of which depicts the effect of fast switching, whereas the other delineates that of slow diffusion. Associated with the underlying systems, there are averaged or limit systems. Suppose that the solution of the corresponding equation has an invariant probability measure $\mu^{\varepsilon,\delta}$ for each pair of the parameters, that the averaged equation has a limit cycle, and that there is an averaged occupation measure μ^0 concentrated on the limit cycle. Our main effort is to prove that $\mu^{\varepsilon,\delta}$ converges weakly to μ^0 as $\varepsilon \to 0$ and $\delta \to 0$ under suitable conditions. Moreover, an application example is considered for demonstration.

HYPERCONTRACTIVITY FOR FUNCTIONAL STOCHASTIC PARTIAL DIFFERENTIAL EQUATIONS

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Key words: Hypercontractivity, functional stochastic partial differential equation, Harnack inequality, coupling.

Mathematical Subject Classification: 60H15, 60J60

Abstract: Explicit sufficient conditions on the hypercontractivity are presented for two classes of functional stochastic partial differential equations driven by, respectively, non-degenerate and degenerate Gaussian noises. Consequently, these conditions imply that the associated Markov semigroup is L^2-compact and exponentially convergent to the stationary distribution in entropy, variance and total variational norm. As the log-Sobolev inequality is invalid under the framework, we apply a criterion presented in the recent paper [7] using Harnack inequality, coupling property and Gaussian concentration property of the stationary distribution. To verify the concentration property, we prove a Fernique type inequality for infinite-dimensional Gaussian processes which might be interesting by itself.

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THE EXISTENCE OF QUASI-STATIONARY DISTRIBUTION FOR BIRTH-DEATH PROCESSES WITH KILLING

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Abstract: In this paper, we obtain that the sufficient and necessary conditions for the existence of Quasi-stationary distribution for birth-death processes with killing, this generalize the work of Erik A.Van Doorn [1]

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APPROXIMATIONS OF STOCHASTIC PARTIAL DIFFERENTIAL EQUATIONS

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Mathematical Subject Classification: Primary 60H15 Secondary 93E20, 35R60.

Abstract: In this paper we show that solutions of stochastic partial differential equations driven by Brownian motion can be approximated by stochastic partial differential equations forced by pure jump noise/random kicks. Applications to stochastic Burgers equations are discussed.

DEGENERATE SDE WITH HÖLDER-DINI DRIFT AND NON-LIPSCHITZ NOISE COEFFICIENT

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Abstract: The existence-uniqueness and stability of strong solutions are proved for a class of degenerate stochastic differential equations, where the noise coeffcicient might be non-Lipschitz, and the drift is locally Dini continuous in the component with noise (i.e. the second component) and locally Hölder-Dini continuous of order $\frac{2}{3}$ in the first component. Moreover, the weak uniqueness is proved under weaker conditions on the noise coefficient. Furthermore, if the noise coefficient is $C^{1+\epsilon}$ for some $\epsilon > 0$ and the drift is Hölder continuous of order $\alpha \in (\frac{2}{3}, 1)$ in the first component and order $\beta \in (0, 1)$ in the second, the solution forms a C^1-stochastic diffeormorphism flow. To prove these results, we present some new characterizations of Hölder-Dini space by using the heat semigroup and slowly varying functions.

RANDOM PERIODIC PROCESSES, PERIODIC MEASURES AND ERGODICITY

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Key words: random periodic processes, periodic measures, invariant measures, Poincaré sections, irreducibility, strong Feller property, ergodic theorem, strong law of large numbers.

Abstract: We prove an ergodic theorem and a mean ergodic theorem in the random periodic regime on a Polish space. We first establish the "equivalence" of random periodic processes and periodic measures. We prove that a random periodic path of a random dynamical system gives a periodic measure. Conversely, in general a periodic measure cannot give a random periodic path on the original probability space. But we can construct an enlarged probability space, on which the extended random dynamical system has a random periodic process. The law of the random periodic process is the periodic measure in the Markovian case. We introduce the idea of Poincaré sections and under the irreducible assumption on Poincaré sections, we obtain the weak convergence of the transition probabilities at the discrete time of integral multiple of the period. Thus we obtain the ergodicity of the invariant measure, which is the mean of the periodic measure over a period interval. The ergodicity and Poincaré sections give a clear geometric picture of random periodic processes. We further prove the strong law of large numbers (SLLN). This is a new class of random processes satisfying the ergodic theory and SLLN complimentary to the existing ergodic theory in the stationary regime. This is a joint work with Chunrong Feng.

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EXPLORATION OF BVP — EXPLICIT SOLUTIONS FOR TWO-DIMENSIONAL QUEUING SYSTEMS

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KEY WORDS: Boundary-value problems; Riemann-Hilber boundary value problems; analytic functions; Markov processes; stationary distributions; queueing systems; generating functions; explicit solutions

MATHEMATICAL SUBJECT CLASSIFICATION: 60J10, 30D20, 30D30

Abstract: Boundary-value problems (BVP) can go back to B. Riemann [1] and D. Hilbert [2] in 1857. Applications in queueing theory started in 1970's. The solution to a BVP is usually in the form of singular integral. Explicit evaluation (with a closed-form solution in terms of given system parameters) of such a singular integral is rarely possible even for some simple systems. While a formal solution to the boundary-value problem exists, it is of interest to see how explicit solutions can be obtained through a BVP. In this talk, we summarize the efforts in the literature and by ourselves. Examples include tandem queueuing systems; Jackson open networks; two-demand models; and symmetric join-the-shortest-queue models.

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STATISTICAL ARBITRAGE AND OPTION PRICES

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Key words: Black-Scholes Theory; Stationary Processes; Statistical Arbitrage

Mathematical Subject Classification: 60G10; 62P05

Abstract: One of the basic hypotheses of Black-Scholes-Merton theory is arbitrage-free. According to their definition, the Casino games are also arbitrage free, although we know there are statistical arbitrages in those games according to the law of large numbers. We price the options based on the ergodic theorem of stationary process, which is statistical arbitrage free.

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OPTIMAL INVENTORY CONTROL WITH PATH-DEPENDENT COST CRITERIA

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Key words: Inventory control, running maximum, ergodic control, constrained minimization, regime-switching diffusion

Mathematical Subject Classification: 93E20, 60H30.

Abstract: This work deals with a stochastic control problem arising from inventory control, in which the cost structure depends on the current position as well as the running maximum of the state process. A control mechanism is introduced to control the growth of the running maximum which represents the required storage capacity. The infinite horizon discounted cost minimization problem is addressed and it is used to derive a complete solution to the long-run average cost minimization problem. An associated control cost minimization problem subject to a storage capacity constraint is also addressed. Finally, as an application of the above results, this paper also formulates and solves an infinite-horizon discounted control problem with a regime-switching inventory model.

This is a joint work with Ananda Weerasinghe (Iowa State University).

FINITE-TIME STABILIZATION OF HIGH-ORDER STOCHASTIC NONLINEAR SYSTEMS

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Abstract: In this talk, we consider the problem of finite-time stabilization for a class of high-order stochastic nonlinear systems. By using Ito's formula, mathematical induction and back-stepping design method, a novel state- feedback controller is constructed to guarantee that the closed-loop high-order nonlinear system has a unique solution and the solution of the closed-loop high-order nonlinear system is finite-time stable. A systematic design algorithm is developed for the construction of the backstepping controller. Finally, the effectiveness of the state-feedback controller is illustrated by two examples.

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