

International Conference on Random Dynamical Systems

June 8-12, 2009

Chern Institute of Mathematics, Nankai University, Tianjin, China

Sponsors:

- Chern Institute of Mathematics
- National Natural Science Foundation of China
- U.S. National Science Foundation

Organization Committee

- Jinqiao Duan, Illinois Institute of Technology
- Yiming Long, Nankai University
- Kening Lu, Brigham Young University

Conference Schedule

All presentations are for 50 minutes, with additional 10 minutes for questions

Monday, June 8

8:15-8:30 Opening Remarks

Chair **Shui-Nee Chow**

8:30-9:30 Manfred Denker, Penn State University
Random Markov Fibred Systems

9:30-10:30 Weinan E, Princeton University
Rare Events in Random Dynamical Systems

10:30-11:00 *Tea Break*

11:00-12:00 Thomas Wanner, George Mason University
The Dynamics of Nucleation in Stochastic Cahn-Morral Systems

Chair **Peter Imkeller**

2:00-3:00 Peter Bates, Michigan State University
Random Attractors for Stochastic Reaction-Diffusion Equations on Unbounded Domains

3:00-4:30 Michael Scheutzow, TU Berlin
Attractors for random dynamical systems on a Euclidean space

4:00-4:30 *Tea Break*

4:30-5:30 Bixiang Wang, New Mexico Institute of Mining & Technology
Random Attractors for Stochastic Wave Equations with Critical Exponents on Unbounded Domains

Tuesday, June 9

Chair **Peter Bates**

8:30-9:30 Shui-Nee Chow, Georgia Institute of Technology
Dynamics of Hydrodynamic Limits of Dissipative Particle Systems

9:30-10:30 Wenxian Shen, Auburn University
*Principal Lyapunov Exponent and
Principal Floquet Bundle of Stochastic/Random Parabolic Equations*

10:30-11:00 *Tea Break*

11:00-12:00 Martin Hairer, New York University
Ergodic Theory of Random Dynamical Systems

Chair **Tom Wanner**

2:00-3:00 Huaizhong Zhao, Loughborough University
*Pathwise Stationary Solution and Random Periodic Solution
of Random Quadratic Maps*

3:00-4:30 Maria Garrido-Atienza, University of Sevilla
*Approximation of Stationary Solutions of Stochastic Differential Equations
Driven by Fractional Brownian Motion*

4:00-4:30 *Tea Break*

4:30-5:30 Kening Lu, Brigham Young University
*Lyapunov Exponents and Invariant Manifolds
for Infinite Dimensional Random Dynamical Systems in a Banach Space*

Chair **Hongjun Gao & Xianjun Wang**

7:00-9:30 Poster Session

Wednesday, June 10

Chair **Dirk Bloemker**

8:30-9:30 Peter Imkeller, Humboldt-Universität
*Simple SDE and Spde Dynamical Models Interpreting Climate Data
and Their Meta-Stability*

9:30-10:30 Hongjun Gao, Nanjing Normal University
Random Dynamics of the 3D Stochastic Navier-Stokes-Voigt Equations

10:30-11:00 *Tea Break*

11:00-12:00 Daoyi Xu, Sichuan University
*Well-posed Problems for Delay Stochastic Equations
in Infinite Dimensions and Existence of Periodic Markov Process*

2:00 – **Local Tour**

1. ABSTRACT for Oral Presentations

Random attractors for Stochastic Reaction-Diffusion Equations on Unbounded Domains

The existence of a pullback attractor is established for a stochastic reaction-diffusion equation on all n -dimensional space. The nonlinearity is dissipative for large values of the state and the stochastic nature of the equation appears as spatially distributed temporal white noise. The reaction-diffusion equation is recast as a random dynamical system and asymptotic compactness for this is demonstrated by using uniform a priori estimates for far-field values of solutions. This is joint work with Kening Lu and Bixiang Wang.

Peter Bates
Michigan State University

Stabilization due to Additive Noise

Abstract: Stabilization due to the presence of multiplicative noise is a well studied phenomenon. Here we review some results on the effect of degenerate additive noise on stabilization. In the talk we mainly focus on equations of Burgers type and the Swift-Hohenberg equation. The analysis is based on the rigorous derivation of a stochastic amplitude equation and on careful estimates on its solution. The amplitude equation relies on the natural separation of time-scales near a threshold of stability. This leads to a reduced model for the dominant pattern or modes. The amplitude equation clearly shows the shift of the threshold of stability. Furthermore, a few numerical examples which corroborate our theoretical findings are presented. Joint work with Martin Hairer (Courant/Warwick), Grigorios A. Pavliotis (Imperial, London), and Wael W.M.E. Elhaddad (Augsburg).

Dirk Bloemker
University of Augsburg

Dynamics of Hydrodynamic Limits of Dissipative Particle Systems

We investigate the macroscopic description of a dilute gas of particles interacting through binary collisions that conserve momentum and mass, but which dissipate energy, as in the case of granular media with inelastic collisions. Our starting point is on the mesoscopic level, through the Boltzmann equation. We deduce hydrodynamic equations for the macroscopic description that would reduce to the compressible Navier-Stokes equations if there were no energy dissipation. We do this in a regime where both the Knudsen number (the ratio of mesoscopic to macroscopic length scales) and the restitution coefficient (which measures the inelasticity) are small but non-zero. In this regime, we show that it is possible to relate the actual dynamics to a reduced dynamics on a slow manifold, which in the limit of zero inelasticity is simply the manifold of local Maxwellian functions, which is constructed for all small inelasticity. Instead of expanding the Boltzmann equation itself, we expand on this manifold. In this way, a number of ideas from the theory of dynamical systems, and especially geometric singular perturbation theory, enter our analysis. We discuss the resulting hydrodynamic equations, and compare them to those obtained by other researchers using other methods (suited to other regimes). As we explain here, the particular regime we investigate is especially interesting in the context of pattern formation.

Shui-Nee Chow
Georgia Institute of Technology

Analytical Properties for Parabolic Stochastic PDEs

We will discuss existence, uniqueness and smoothness of the solution for a large class of parabolic stochastic PDEs on bounded domains driven by a Gaussian noise. The results will be stated in terms of spectral properties of the elliptic operator from the deterministic part and asymptotic properties of the correlation structure of the noise term. In particular we will cover some classical results and argue that the imposed conditions are necessary and sufficient.

Igor Cialenco
Illinois Institute of Technology

Generic Properties of Lyapunov Spectrum of Linear Random Dynamical Systems

Lyapunov exponents and Lyapunov spectrum are important tools in the theory of dynamical systems. They characterize basic qualitative properties of dynamical systems: stability, hyperbolicity, chaos, etc. In this talk I will present some results on generic properties of Lyapunov spectrum in the space of linear random dynamical systems.

Nguyen Dinh Cong
Institute of Mathematics, Vietnam Academy of Science and Technology

Random Markov Fibred Systems

The talk reports on two recent joint works with Yuri Kifer and Manuel Stadlbauer. We define random Markov fibred systems as a generalized random dynamical systems, where the fibres are locally mapped to fibres over orbit equivalent points. We show that these systems are conservative or totally dissipative (under the classical conditions). We then discuss some aspects of thermodynamic formalism for random countable Markov shifts, generalizing work of O. Sarig. We show the existence of the relative pressure and use Crauel's Prohorov theorem to construct relative equilibrium measures.

Manfred Denker
Pennsylvania State University

Ergodicity of Stochastic 2D Navier-Stokes Equations with Lévy Noise

This talk is concerned with 2D Navier-Stokes equation with Levy noise. The existence and uniqueness of the global strong and weak solutions and the existence of invariant measures is proved in in our previous paper. But in that framework, it seems that it is impossible to get the strong Feller property. In this talk, we show that the on a suitable state space, the solution is strong Feller. For getting the ergodicity, the priori estimations and stopping time technique play the key role.

Zhao Dong
Chinese Academy of Sciences

Stochastic Quantification of Missing Mechanisms in Dynamical Systems

Complex dynamical systems are sometimes subject to uncertainties, since some mechanisms are not represented (i.e., "unresolved"), due to lack of better scientific understanding for these mechanisms. The impact of these unresolved mechanisms on resolved ones may be delicate and needs to be quantified or taken into account. The speaker presents an overview of recent works in stochastic quantification of missing mechanisms in the framework of Random Dynamical Systems. The relevant dynamical systems issues are impact of uncertainty, small noise limit, rare events, noise-induced phenomena, stochastic parameterizations, parameter estimations, non-Gaussian and colored noises. The related dynamical systems concepts are invariant manifolds, bifurcation, deviation, mean exit time and escape probability.

Jinqiao Duan
Illinois Institute of Technology

Rare Events in Random Dynamical Systems

Many processes in nature are rare events. Important examples include chemical reactions, conformation changes of molecules and noise-induced transition to turbulence. Mathematically, they are an important feature of dynamical systems perturbed by small random noises. I will give an overview of this subject, including the main theoretical work, numerical issues and some examples of applications.

Weinan E
Princeton University and Peking University

Approximation of Stationary Solutions of Stochastic Differential Equations Driven by Fractional Brownian Motion

In this talk we study the behavior of dissipative systems with additive fractional noise of any Hurst parameter. Under a one-sided dissipative Lipschitz condition on the drift the continuous stochastic system is shown to have a unique stationary solution, which pathwise attracts all other solutions. The same holds for the discretized stochastic system, if the drift-implicit Euler method is used for the discretization. Moreover, the unique stationary solution of the drift-implicit Euler scheme converges to the unique stationary solution of the original system as the stepsize of the discretization decreases. This is a joint work with P.E. Kloeden (University of Frankfurt, Germany) and A. Neuenkirch (University of Dortmund, Germany)

Maria Garrido-Atienza
University of Sevilla

Random Dynamics of the 3D Stochastic Navier-Stokes-Voigt Equations

The 3D Navier-Stokes-Voigt model of viscoelastic incompressible fluid with random influence is investigated. We prove the existence and uniqueness of weak solution by the use of Feaodo-Galerkin method and then show that the long time dynamics is captured by a random attractor with finite Hausdroff dimension.

Hongjun Gao
Nanjing Normal University

Ergodic Theory of Random Dynamical Systems

In this work, our aim is to obtain criteria for the uniqueness of a (non-anticipative) invariant measure for discrete-time random dynamical systems. We show that there is an analogue in this setting to the usual Doob-Khoshminski ergodicity criterion, provided that the driving noise satisfies a certain "quasi-Markov" property. This can be verified in many cases, including SDEs driven by fractional Brownian motion and thus having long-range memory.

Martin Hairer
New York University

Simple SDE and Spde Dynamical Models Interpreting Climate Data and Their Meta-Stability

Simple models of the earth's energy balance are instrumental for interpreting some qualitative aspects of the dynamics of paleo-climatic data. In the 1980s this led to the investigation of periodically forced dynamical systems of the reaction-diffusion type with small Gaussian noise, and a rough explanation of glacial cycles by Gaussian meta-stability. A spectral analysis of Greenland ice time series performed at the end of the 1990s representing average temperatures during the last ice age suggest an α -stable noise component with an $\alpha \sim 1 : 75$. Based on this observation, papers in the physics literature attempted an interpretation featuring dynamical systems perturbed by small Lévy noise. We study exit and transition between meta-stable states for solutions of stochastic differential equations and stochastic reaction-diffusion equations derived from this prototype. Due to the heavy-tail nature of its α -stable component, the results for Lévy noise differ strongly from the well known case of purely Gaussian perturbations. For SPDE, transitions are governed by the modes with the largest jumps.

Interpreting paleo-climatic time series by simple dynamical systems with noise leads to statistical model selection problems. For instance, one needs an efficient testing method for the best fitting α -stable noise component. We develop a statistical testing method based on the p-variation of the solution trajectories of SDE with Lévy noise, for example by showing asymptotic normality or asymptotic β -stability of their approximations along finite interval partitions.

It has been suggested that the exit and transition characteristics of dynamical systems perturbed by small Lévy noise approach Gaussian behavior as the heavy tails of their jump laws become

exponentially light of order γ , i.e. if for $x \rightarrow \infty$ they are given by $\exp(-cx^\gamma)$, and as $\gamma \rightarrow 2$. We show that this is surprisingly false, by exhibiting an intriguing phase transition at $\gamma = 1$. This is joint work with Claudia Hein, Michael Hogele, Ilya Pavlyukevich, Torsten Wetze

Peter Imkeller
Humboldt-Universität

Random Conley-Markov Connection Matrix for Gradient Flows

We study the random perturbation of a gradient flow and analyze its Conley connection matrix for the finite time period. The connection matrices are combined from the Conley connection matrix from the usual Dynamical system and the Fokker-Planck transition matrix from the random Dynamical system. The Random Conley-Markov connection matrix contains more information about the structure of the random dynamic system and the information about the global maxima/minima. Some examples will be discussed. This is a joint work with Shui-Nee Chow and Hao-Min Zhou.

Weiping Li
Oklahoma State University

A Study of a Stochastic Differential Equation.

The solution to an ordinary differential equation depends on its initial data continuously provided that it has a global solution. This is not the case for stochastic differential equations. Positive results have been searched for long and hard. For a global strong solution to exist, the vector fields should have linear growth at infinity (in the forward direction), allowing logarithmic order corrections. The regularity needed for the vector fields are locally Lipschitz. The question is how to construct examples of conservative SDEs which has no global smooth solutions. The counter examples we knew so far do not satisfy the linear growth condition. We construct a SDE without a global smooth flow whose coefficients are bounded and smooth. Only finite dimensional noise is needed. This is joint work with M. Scheutzow.

Xue-Mei Li
University of Warwick

Identification of Linear Stochastic Systems that are Second Order in Time

For an Ornstein-Uhlenbeck process $\dot{X}(t) = aX(t)dt + w(t)$, observed in continuous time, the maximum likelihood estimator of the coefficient a is

$$\hat{a} = \frac{X^2(T) - T}{2 \int_0^T X^2(t)dt};$$

the properties of this estimator are well-studied. The stable process (with $a < 0$) also appears in the analysis of stochastic parabolic equations, and the corresponding estimation problems have been well-studied as well.

A lot less is known about equations that are second order in time:

$$\ddot{X} + 2a\dot{X} + bX = w(t).$$

For certain values of a and b , such equations appear as spatial Fourier coefficients of solutions of stochastic hyperbolic equations. The extra unknown parameter and the variety of different solution regimes make the estimation problem for such equations much more challenging.

In the talk, I will discuss the construction and the asymptotic behavior of the maximum likelihood estimators for second-order stochastic evolution equations, both ordinary and with partial derivatives, and discuss some numerical questions related to computing the estimators. This is a joint work with Ning Lin and Wei Liu.

Sergey Lototsky
University of Southern California

Lyapunov Exponents and Invariant Manifolds for Infinite Dimensional Random Dynamical Systems in a Banach Space

We studied the Lyapunov exponents and their associated invariant subspaces for infinite dimensional random dynamical systems in a Banach space, which are generated by, for example, stochastic or random partial differential equations. We proved a multiplicative ergodic theorem. Then, we used this theorem to establish the stable and unstable manifold theorem for nonuniformly hyperbolic random invariant sets. This is a joint work with Zeng Lian.

Kening Lu
Brigham Young University

Probabilistic Representation of an Irregular Porous Media Type Equation and Related Fields

We consider a (generalized) porous media type equation over all of \mathbb{R}^d with $d = 1$, with monotone discontinuous coefficients with linear growth and prove a probabilistic representation of its solution in terms of an associated microscopic diffusion. This equation is motivated by some singular behaviour arising in complex self-organized critical systems. One of the main analytic ingredients of the proof, is a new result on uniqueness of distributional solutions of a linear PDE on \mathbb{R}^1 with non-continuous coefficients. This talk is based on two joint papers: the first with Ph. Blanchard and M. Röckner, the second one with V. Barbu and M. Röckner.

Francesco Russo
INRIA Rocquencourt, Projet MATHFI and Université Paris 13.

Principal Lyapunov Exponent and Principal Floquet Bundle of Stochastic/Random Parabolic Equations

The present talk is concerned with the extension of the classical principal eigenvalue and principal eigenfunction theory for elliptic and time periodic parabolic equations to stochastic/random parabolic ones. By applying the general multiplicative ergodic theorems, Hilbert projective metric, and heat kernel estimates, it is shown that under some quite general and natural assumption, the principal Lyapunov exponent of a stochastic/random parabolic equation is simple in the sense that the principal Floquet bundle or the Oseledec's space associated with the principal Lyapunov exponent is one dimensional. Moreover, it is shown that the functions in the principal Floquet bundle does not change sign. Principal Lyapunov exponent and principal Floquet bundle of stochastic/random parabolic equations are the analog of the principal eigenvalue and principal eigenfunction of elliptic and time periodic parabolic problems and provide a basic tool for the study of nonlinear stochastic/random parabolic equations. The talk will also discuss the applications of the principal Lyapunov exponent and principal Floquet bundle theory for stochastic/random parabolic equations in some biological model.

Wenxian Shen
Auburn University

Attractors for Random Dynamical Systems on a Euclidean Space

We provide sufficient conditions on the coefficients of a stochastic differential equation on a Euclidean space in order that the associated random dynamical system (rds) admits a random attractor. Roughly speaking, the drift vector field has to point towards the origin in order for an attractor to exist. For the proof, we use chaining techniques in order to control the growth of small balls under the rds. We also provide an example of an rds generated by a stochastic differential equation which does not possess an attractor even though its Markov semigroup admits a (unique) invariant probability measure. This is joint work with Georgi Dimitroff (Berlin).

Michael Scheutzow
TU Berlin

Random Attractors for Stochastic Wave Equations with Critical Exponents on Unbounded Domains

The existence of a random attractor in $H^1(\mathbb{R}^n) \times L^2(\mathbb{R}^n)$ is proved for the damped semilinear stochastic wave equation defined on the entire space \mathbb{R}^n . The nonlinearity has a critical growth rate in the three-dimensional case. The uniform pullback estimates on the tails of solutions for large space variables are established. The pullback asymptotic compactness of the random dynamical system is proved by using these tail estimates and the energy equation method.

Bixiang Wang
New Mexico Institute of Mining & Technology

The Dynamics of Nucleation in Stochastic Cahn-Morral Systems

Stochastic Cahn-Morral systems serve as basic models for several phase separation phenomena in multi-component metal alloys. In this talk, I will discuss dynamical aspects of a certain type of phase separation – known as homogeneous nucleation – in which the material separates into small droplets. Numerical studies will be presented in the context of alloys consisting of three metallic components which give a statistical classification for the distribution of droplet types as the component structure of the alloy is varied. We relate these statistics to the equilibrium structure of the deterministic Cahn-Morral system and show that even highly unstable equilibria can be observed during the nucleation process, and in fact serve as organizing centers for the dynamics.

Tom Wanner
George Mason University

Well-posed Problems for Delay Stochastic Equations in Infinite Dimensions and Existence of Periodic Markov Process

In this talk, we will present some basic results on well-posed problems for delay stochastic equations in infinite dimensions and the existence of periodic Markov process.

Daoyi Xu
Sichuan University

TBA

Lai-Sang Young
New Yorke University

The Stationary Solutions of SPDEs via Backward Doubly SDEs

We study the existence of stationary solutions for stochastic partial differential equations (SPDEs). We establish a new connection between solutions of backward doubly stochastic differential equations (BDSDEs) on infinite horizon and the stationary solutions of the SPDEs. For this, we prove the existence and uniqueness of solutions of both finite and infinite horizon BDSDEs with Lipschitz nonlinear term in a weighted L^2 space, so obtain the solutions of initial value problems and the stationary weak solutions (independent of any initial value) of SPDEs. Also the SPDEs and BDSDEs with non-Lipschitz term are considered. The connection of the weak solutions of SPDEs and BDSDEs has independent interests in the areas of both SPDEs and BSDEs.

Qi Zhang
Fudan University

Phase Noise in Oscillators and Fokker-Planck Equations

I will present a local moving orthonormal transformation that has been introduced to rigorously study phase noise in stochastic differential equations (SDEs) arising from nonlinear oscillators. A general theory of phase and amplitude noise equations and its corresponding FokkerPlanck equations

are derived to characterize the dynamics of phase and amplitude error. Some recent results on couple stochastic oscillators will also be discussed.

Haomin Zhou
Georgia Institute of Technology

Pathwise Stationary Solution and Random Periodic Solution of Random Quadratic Maps

We prove the existence of the stationary solutions and random periodic solutions of period two for the random quadratic maps. This is a joint work with Peng Lian.

Huaizhong Zhao
Loughborough University

Random Periodic Solutions of Random Dynamical System

In this talk we will give the definition of the random periodic solutions of random dynamical system. We will prove the existence of such periodic solutions for a C^1 perfect cocycle on a cylinder using a random invariant set, the Lyapunov exponents and the pullback of the cocycle.

Zuohuan Zheng
Chinese Academy of Sciences

2. ABSTRACT for Poster Presentations

Bifurcation in random dynamical systems

Xiaopeng Chen
School of Mathematics and Statistics
Huazhong University of Science and Technology
Wuhan 430074, China
E-mail: *chenxiao002214336@yahoo.cn*

Some properties of random Conley index are obtained and then a sufficient condition for the existence of abstract bifurcation points for both discrete-time and continuous-time random dynamical systems is presented. This stochastic bifurcation phenomenon is demonstrated by a few examples.

Global asymptotic stability of solutions of nonautonomous master equations

Berton Earnshaw
University of Utah, USA
Email: *earnshaw@math.utah.edu*

We provide various conditions on the transition rate matrix of the (possibly nonautonomous) master equation of a finite-state, continuous-time jump process under which every probability distribution solution is globally asymptotically stable in the set of such solutions, thereby extending van Kampen's theorem for constant transition rate matrices. We show that each set of conditions is a special case of a more general integrability condition on the (possibly time-dependent) eigenvalues of the transition rate matrix, and we conjecture that this integrability condition is sufficient to ensure the global asymptotic stability of probability distribution solutions. We demonstrate that the converse of this conjecture is not true in general by providing a counterexample.

Wellposedness for stochastic partial differential equations by examples

Hongbo Fu
School of Mathematics and Statistics
Huazhong University of Science and Technology
Wuhan 430074, China
E-mail: *hbfbu_hust@sina.com*

To facilitate random dynamical systems approach for stochastic partial differential equations arising as mathematical models for complex systems under fluctuations in science and engineering, global existence and uniqueness of mild solutions for a class of stochastic partial differential equations with local Lipschitz coefficients are considered. A sufficient condition for global existence and uniqueness of mild solutions is provided and a few examples are presented to demonstrate the result.

Asymptotic Behavior of stochastic parabolic equations with delays

Jianhua Huang (Joint work with Jin Li and Yan Zheng)
Department of Mathematics, National University of Defense Technology
Changsha, 410073, China
jhhuang32@nudt.edu.cn

The existence of a random attractor is established for stochastic parabolic equation with delays and additive white noise.

$$\begin{cases} \frac{\partial u(t, x)}{\partial t} + Au(t, x) + bu(t, x) = F(u_t)(x) + \sum_{j=1}^m \beta_j(x) \frac{d}{dt} w_j(t), & x \in D. \\ u(0, x) = u_0(x), \quad u(s, x) = \psi(s, x), & s \in (-r, 0), \end{cases}$$

The continuity of random attractor of perturbed stochastic parabolic equation with delays to global attractor of determined one is proved. Moreover, we investigate asymptotic behaviors of invariant measures for stochastic parabolic systems with delays and additive white noise when size of noise gets to zero. The existence and uniqueness of invariant measures are also provided, which mix exponentially.

Random Substitutions

David Koslicki
Penn State University, USA
koslicki@math.psu.edu

While deterministic substitutions acting on strings have been well studied, very little is known about the randomized counterpart. Included here is an overview of what is known about random substitutions and a discussion of examples, techniques and possible applications.

Synchronization of dissipative systems driven by non-Gaussian noises

Xianming Liu
School of Mathematics and Statistics
Huazhong University of Science and Technology
Wuhan 430074, China
mathliu.xm@yahoo.cn

A coupled dynamical system under non-Gaussian Levy noises is considered. After discussing cocycle property, stationary orbits and random attractors, a synchronization phenomenon is shown to occur, when the drift terms of the coupled system satisfy certain dissipativity and integrability conditions. The synchronization result implies that coupled dynamical systems share a dynamical feature in some asymptotic sense.

Statistical Inference for Stochastic Wave Equation

Wei Liu
University of Southern California, USA
Email address: Liu5@usc.edu

A parameter estimation problem is considered for a one-dimensional stochastic wave equation by additive space-time Gaussian white noise. The asymptotic properties of the estimator are studied as the number of the Fourier coefficient increases, while the observation time and the noise intensity are fixed.

Homeomorphism Flows for Non-Lipschitz SDEs Driven by Lévy Processes

Huijie Qiao
Department of Mathematics, Southeast University
Nanjing, Jiangsu 211189, China
Email: hjqiaoqean@yahoo.com.cn

In this paper an Itô-Ventzell formula for processes with jumps is proved and homeomorphism flows for non-Lipschitz stochastic differential equations driven by Lévy processes are studied.

Study noise-induced transitions in the Kuramoto-Sivashinsky equation via the minimum action method

Xiaoliang Wan, Xiang Zhou and Weinan E
Program in Applied and Computational Mathematics
Princeton University, USA
xiaolian@math.princeton.edu

In this work, we investigate the noise-induced transitions for the Kuramoto-Sivashinsky (K-S) equation. We study a low-dimensional Fourier approximation of the K-S equation, which results in a non-gradient dynamical system. The main technique tool is the adaptive minimum action method based on the large deviation theory of random dynamical systems, which requires a numerical solution of an optimization problem. We study the transition between a stable fixed point and a stable traveling wave. Five saddle points, up to a constant due to the translational invariance, are identified efficiently based on the information given by the minimum action path (MAP). Heteroclinic orbits between the saddle points are figured out, and relations between the transitions and the saddle points are examined.

Wick Filtration and Quantum Stochastic Equations

Caishi Wang
School of Mathematics and Information Science, Northwest Normal University

Lanzhou 730070, China
cswangnwnu@163.com

A filtration, called Wick filtration, is constructed of white noise operators. A notion of adaptedness to the filtration is defined for quantum stochastic processes in terms of white noise operators. Solutions adapted to the filtration are examined of quantum stochastic differential equations in terms of white noise operators.

The mechanisms of simple perceptual decision-making processes

Xueying Wang

Department of Mathematics, The Ohio State University, USA

Email: xueying@math.ohio-state.edu

Perceptual decision-making, an omnipresent component of everyday life, plays a pivotal role in cognitive tasks. How does a simple two-alternative perceptual decision-making work? In this presentation, we will talk about the mechanisms underlying simple two-option perceptual decision-making processes by studying a biological-realistic reduced two-variable model and phenomenological drift-diffusion models.

Sufficient conditions for the existence of global random attractors for stochastic lattice dynamical systems and applications

Caidi Zhao

Department of Mathematics and Information Science

Wenzhou University

Zhejiang Province, 325035, China

zhaocaidi@yahoo.com.cn

We first present some sufficient conditions for the existence of a global random attractor for general stochastic lattice dynamical systems. The sufficient conditions provide a convenient approach to obtain an upper bound of Kolmogorov ε -entropy for the global random attractor. Then we apply the abstract result to the stochastic lattice sine-Gordon equation. This is joint work with Shengfan Zhou.

Noise-induced transition pathways in the Lorenz system

Xiang Zhou

Princeton University, USA

We investigate noise-induced transitions in the Lorenz system with three representative Rayleigh number regimes. One pair of unstable limit cycles, which continue from the homoclinic trajectory, plays the role of the most probable exit set in the transition process. This example demonstrates how limit cycles, the next simplest invariant set beyond fixed points, can be involved in the transition process in smooth dynamical systems.

Mean square stability of nonlinear systems with random delay and markovian jump parameters

Enwen Zhu^{1,2}, Hanjun Zhang², Jiezhong Zou³

¹ School of Mathematics and Computational Science, Changsha University of Science and Technology, 410076 Hunan, China

² School of Mathematics and Computational Science, Xiangtan University, 411105 Hunan, China

³ School of Mathematics, Central South University, 410075 Hunan, China

(e-mail: engwenzhu@126.com)

The problems of stochastic stability for a class of nonlinear systems with random delay and Markovian jump parameters are investigated. The jumping parameters and delay are modeled as a continuous-time, discrete-state Markov process. Systems of this type may arise in real-time control

applications. Employing a delay-averaging approach we demonstrate how certain mean-square stochastic stability conditions can be derived in terms of transition functions of the Markov process and stability properties of a system with a constant delay.

Existence, stability and convergence of stationary solutions of nonlinear random difference equations

Mei Zhu, Duo Wang, and Maozheng Guo

School of Mathematical Sciences, Peking University, China

meizhu66@gmail.com

We study stationary solutions of nonlinear random difference equations. Firstly, we give sufficient conditions that guarantee the stability of Lypanunov exponents. Secondly, we find out the conditions under which the ratio of the random norm and the standard Euclidean norm has deterministic bounds. Based on these new results, we provide new conditions that guarantee the existence and almost sure stability of a stationary solution to random difference equations. In addition, we prove that the stationary solution converges with probability one to the fixed point of the corresponding deterministic system as the noise intensity tends to zero. Finally, we apply the obtained results to an example of a financial model with random dividends.