Workshop at the ZiF, Bielefeld

Stochastics and Real World Models II

IGK "Stochastics and Real World Models"
Beijing – Bielefeld

www.math.uni-bielefeld.de/igk/

August 27–31, 2007

Spokesmen of the IGK:
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Programme

Times	Monday	Tuesday
8:50	Opening	
9:00–9:40	Z.M. Ma, *Markov Chain Methods in Internetwork and Search Engines*	G. Da Prato, *The Infinitesimal Generator of a Stochastic Differential Equation with Monotone Drift*
9:50–10:30	V.I. Bogachev, *Upper and Lower Bounds for the Densities of Stationary Distributions and Transition Probabilities of Diffusions*	V. Barbu, *The Kolmogorov Operator Associated with 1-D Parabolic Stochastic Problem with Reflection*
10:40–11:10	— coffee break —	
11:10–11:50	L. Streit, *Portraits of Large Networks*	P. Lescot, *Stochastic Attractors for the Porous Media Equation*
12:00–13:30	— lunch break —	
13:30–14:10	D. Volchenkov, *City Space Syntax as a Complex Network*	G.Q. Lan, *(Quasi-)Regular Dirichlet Forms for Particle Systems on Polish Spaces*
14:20–15:00	S. Sun, *Coverage and Connectivity of Randomly Deployed Sensor Networks*	S.X. Ouyang, *Harnack Inequality for SDE*
15:10–15:40	— coffee break —	
15:40–16:20	L. Xiao, *A Model with Power-Law Distribution of Peninsula Size*	J.M. Tölle, *Nonlinear Forms, Saddle Functions and Operators: Variational Convergence along a Sequence of Hilbert Spaces*
16:30–17:10	P. Jin, *Stochastic Dynamics Associated with Gibbs Measures on Infinite Graphs*	W. Liu, *Some Properties of the Solution to Stochastic Evolution Equations with Monotone Coefficients*

Wednesday	Thursday	Friday
F. Russo, *Calculus Related to Financial Assets without Semimartingale*	Ph. Blanchard, *Decoherence Scenarios in Infinite Quantum Systems*	Y.G. Kondratiev, *Stochastic Models of Complex Adaptive Systems*
F. Riedel, *Irreversible Investment*	F. Götze, *Asymptotic Approximations in Free Probability and Random Matrix Ensembles*	T. Pasurek, *Ergodicity of Glauber Dynamics for Unbounded Spin Systems*
	— coffee break —	
W. Trockel, *On the Concept of Implementation in Economic Theory*	F. Torres, *On the Probabilistic Longest Subsequence Problem: Recent Results*	N. Li, *Quantumness of Bipartite States in Terms of Conditional Entropies*
	— lunch break —	
C. Marinelli, *Local Well-Posedness of Musiela's SPDE with Lévy Noise*	A. Pachon, *Scenery Reconstruction in Polynomial Time*	N. Ohlerich, *Selection-Mutation Balance Models with Epistatic Selection*
E. Nugroho, *Basic Models for the Fund Manager's Incentive Scheme*	Round Table Meeting	O. Byegunova, *Solitary burn-up waves in the neutron-multiplicating medium. Recent results*
	— coffee break —	
	(Round Table Meeting)	T. Kuna, *Contact Model in the Continuum*

Abstracts

(sorted alphabetically by the family names of the speakers)

Decoherence Scenarios in Infinite Quantum Systems
(Philippe Blanchard, Bielefeld)

Decoherence is an extremely fast and efficient environment-induced irreversible process transforming quantum superpositions into statistical mixtures. It is an essential step in quantum measurement and a formidable obstacle for practical use of quantum superpositions, quantum computing for instance. We describe various physical effects resulting from environmental decoherence in the framework of algebraic quantum field theory.

References:

- Ph. Blanchard, R. Olkiewicz, *Decoherence as Irreversible Dynamical Process in Open Quantum Systems*, in "Open Quantum Systems III - Recent Developments", Lecture Notes in Mathematics **1882**, Springer (2006).
- Ph. Blanchard, M. Hellmich, P. Lugiewicz, R. Olkiewicz, *Quantum dynamical semigroups for finite and infinite Bose systems*, Journal of Mathematical Physics **48**, 012106 (2007).

Solitary burn-up waves in the neutron-multiplicating medium. Recent results
(Olga Byegunova, Bielefeld)

Progress overview of the analysis of the properties of nonlinear parabolic equations related to infinite particle systems, corresponding to solitary burn-up waves in the neutron-multiplicating medium.

Asymptotic Approximations in Free Probability and Random Matrix Ensembles
(Friedrich Götze, Bielefeld)

We investigate asymptotic limit laws for free additive convolutions of renormalized identical spectral p-measures and derive Edgeworth type expansions in this case with errors up to $o(n^{-1})$ using approximation terms different from classical Probability.
This is joint work with G. Chistyakov.

For non hermitean Wigner matrix ensembles we show convergence of the complex spectrum (after renormalization) to the circle law (uniform distribution in the unit disk) for arbitrary matrices assuming moment conditions only. Analogous results hold for some subclasses of sparse Wigner matrices.
This is joint work with A. Tikhomirov.

Stochastic Dynamics Associated with Gibbs Measures on Infinite Graphs
(Peng Jin, Bielefeld)

We study interacting particle systems on infinite graphs. As in the lattice case, Gibbs measures can be characterized as quasi-invariant measures with given Radon-Nikodym derivatives. Therefore we could construct the stochastic dynamics associated with a Gibbs measure via Dirichlet form method. The ergodic property of this dynamics will also be explored.

Contact Model in the Continuum
(Tobias Kuna, Bielefeld)

In this talk I will give an overview over recent results for the contact model in the continuum. The construction of the process and the corresponding invariant measures will be described. The hydrodynamic and the fluctuation limit of the process will be presented. The treatment of the the contact process in the continuum is more direct than on the lattice, because the breaking of symmetry due to the lattice structure prevent several explicit representations.

(Quasi-)Regular Dirichlet Forms for Particle Systems on Polish Spaces
(Guang-Qiang Lan, Beijing)

Explicit sufficient and necessary conditions are presented for reaction-diffusion type Dirichlet forms on Polish spaces studied in a paper of Röckner and Wang (in 2006) to be (quasi-)regular. As preliminary, the (quasi-)regularity of the sum of two or countably many Dirichlet forms is investigated.

Stochastic Attractors for the Porous Media Equation
(Paul Lescot, St. Quentin)

Under suitable conditions, we shall prove the existence of a stochastic attractor (in the sense of Crauel) for the porous media equation, and establish that this attractor consists of a single point.

The general framework has been formulated in the foundational paper by Da Prato, Röckner, Rozovskii and Wang (*Communications in Partial Differential Equations*, 2006). Some of our computations are analogous to the ones of Crauel and Flandoli (*Probability Theory and related Fields*, 1994) for the reaction-diffusion equation with additive noise.

Our results apply, for instance, to the equation:

$$\mathrm{d}X_t = \Delta(X_t^3) + B\,\mathrm{d}W_t\ .$$

This is work in progress, joint with Professor Michael Röckner (Bielefeld).

Quantumness of Bipartite States in Terms of Conditional Entropies
(Nan Li, Beijing)

First, we will study the different quantum analogues of the classical conditional entropy. Then we will introduce two alternative variants of quantum conditional entropies via conditional density operators, which are intrinsic in contrast to the Olliver-Zurek method that involves extrinsic local measurements. The significance of these quantum conditional entropies in characterizing quantumness of bipartite states are illustrated through several examples.

Some Properties of the Solution to Stochastic Evolution Equations with Monotone Coefficients

(Wei Liu, Bielefeld)

In this talk I will give some recent results for the properties of the solution to a class of SPDE with monotone coefficients. More precisely, the preservation of the solution in subspace of state space, Large deviation principle and Harnack inequality will be presented. This work mainly follows the line of some recent joint-papers of Barbu, Da Prato, Roeckner and Wang et al.

Markov Chain Methods in Internetwork and Search Engines

(Zhi-Ming Ma, Beijing)

In this talk I shall briefly review some of our recent results (in collaboration with Microsoft Research Asia) on the design and analysis of search engines on the Internetwork.

The contents include: the limiting behavior of the damping Markov chains in PageRank; comparison of the convergence rate of irreducible Markov chains on the Internet; Markov chain methods in ranking Websites; Supervised Markov chain rank aggregation; Query level statistical learning in Information Retrieval.

Basic Models for the Fund Manager's Incentive Scheme

(Eko Nugroho, Bielefeld)

We consider a situation when the investor need to hire a fund manager drawn from the population. With the assumption that the manager is able to learn a noisy signal from the market, we try to present some basic model for the fund manager's incentive scheme in a single period and a simple two period contracting term. The investor's single period problem is formulated as a screening problem. The sequence of actions taken by both parties and some direct consequences from those actions in the two period contracting term will be discussed in detail.

Harnack Inequality for SDE

(Shun-Xiang Ouyang, Bielefeld)

The purpose of the talk is to set up dimension free Harnack inequality for the semigroup corresponding to solution of a stochastic differential equation by the method of coupling combining with Girsanov transformation.

Scenery Reconstruction in Polynomial Time
(Angelica Pachon, Bielefeld)

Assume a random walk moving around on a landscape and making observation thereof. The landscape is called scenery. We assume that we can only have the observations made by random walk. We show that a finite piece of scenery can be reconstructed in polynomial time with high probability. That means that we only have finite many observations. The number of observations we are allowed to see is polynomial in the length of the piece we reconstruct. We also show how to implement such a reconstruction algorithm in practise. All this is done in the context of a 3-colour scenery seen along a simple random walk.

Ergodicity of Glauber Dynamics for Unbounded Spin Systems
(Tanja Pasurek, Bielefeld)

We consider an infinite system of interacting nonlinear diffusions of gradient type. An explicit condition on the strength of the interaction is given, which garanties the pointwise ergodicity of the dynamics outside the dissipativity regime. The exponential convergence in Wasserstein metrics to the unique invariant distribution is obtained.

Irreversible Investment
(Frank Riedel, Bielefeld)

This paper develops a general theory of irreversible investment. We prove first a general existence result. We then show by a new approach that the optimal policy is a base capacity policy. The firm invests in a minimal way to keep capacity above some stochastic lower bound, the base capacity. This base capacity is explicitly constructed. Our method allows qualitative insights into the nature of the optimal investment. We show that the marginal profit is equal to the user cost of capital in free intervals where investment occurs in an absolutely continuous way at strictly positive rates. In blocked intervals, the equality is maintained only in expectation on average. Furthermore, general monotone comparative statics results are derived. When the operating profit function is supermodular, the base capacity increases monotonically with the exogenous shock; and firm size is decreasing in user cost of capital. Finally, explicit solutions are derived in Lévy models.

Calculus Related to Financial Assets without Semimartingale
(Francesco Russo, Paris)

This talk does not suppose a priori that the evolution of the price of a financial asset is a semimartingale. The stochastic integral intervening in the definition of self-financing property is forward integral. If one requires that a certain minimal class of investor strategies are self-financing, previous prices are forced to be finite quadratic variation processes. The non-arbitrage property is not excluded if the class $\mathcal{A}$ of admissible strategies is restricted. The classical notion of martingale is replaced with the

notion of $\mathcal{A}$-martingale. A calculus related to $\mathcal{A}$-martingales with some examples is developed. Some applications to no-arbitrage, viability, hedging and the maximization of the utility of an insider are expanded.

This is based on a joint work with Rosanna Coviello.

Coverage and Connectivity of Randomly Deployed Sensor Networks
(Suyong Sun, Beijing)

In this talk, I will present some results about the connectivity and coverage problems of randomly deployed sensor networks. Using Point process model and Stein-Chen method, we obtained some necessary and sufficient conditions on the minimum sensing radius. Finally, I will introduce some currently interested problems on this topic.

Nonlinear Forms, Saddle Functions and Operators: Variational Convergence along a Sequence of Hilbert Spaces
(Jonas M. Tölle, Bielefeld)

We analyze properties of variational convergence of a certain class of nonlinear forms, skew-symmetric convex-concave saddle functions, as e.g. studied by Rockafellar, and hemicontinuous, coercive, maximal monotone operators defined not on one, but a sequence of Hilbert spaces $\{H_n\}$. The case of maximal cyclically monotone operators and subgradients is also dealt with. We will give necessary and sufficient conditions on strong graph convergence of operators, strong convergence of resolvents and semigroups and some variational convergence of the forms in the sense of Mosco, or more precisely, in the nonlinear case, in the sense of Attouch and Wets. We will also expand the method of Moreau–Yosida approximates. Everything is done in the Kuwae–Shioya framework of changing Hilbert spaces, which means in applications the following: Let A^n be a maximal monotone operator defined on $L^2(E;\mu_n)$, where E is a Polish space and μ_n a fully supported finite Borel measure. Now we give a natural definition for the convergence of A^n to some limit A where likewise $L^2(E;\mu_n)$ converges "along" to $L^2(E;\mu)$ in some weak sense (e.g. $\mu_n \to \mu$ weakly). All equivalences to variational convergence (partly dating back to the 1980s) apply to this more general framework of changing reference measures. A Neveu–Trotter–Kato type Theorem is proved.

On the Probabilistic Longest Subsequence Problem: Recent Results
(Felipe Torres, Bielefeld)

Let L_n designate the length of the Longest Common Subsequence of two independent i.i.d. sequences of Bernoulli random variables of length n. Previous works by Matzinger H., Lember J., Houdre C. and Bonetto F. had showed that under different assumptions concerning the Bernoulli parameter, the alphabet used and the periodicity of the sequences, the order of the standard deviation of L_n is $\Theta(\sqrt{n})$. Unfortunately those cases do not include the simplest one: Bernoulli sequences with parameter $1/2$ over a binary alphabet. In this talk I will discuss recent results concerning two binary

sequences with Bernoulli parameter $1/2$ via a modification of the technique used for binary sequences with a small Bernoulli parameter.

On the Concept of Implementation in Economic Theory
(Walter Trockel, Bielefeld)

The basic concept of implementation in equilibria is introduced and illustrated and the idea of extensions to stochastic dynamic issues is discussed.

City Space Syntax as a Complex Network
(Dimitry Volchenkov, Bielefeld)

Space syntax determines our ability to move through a city. It is shaped by many historical, economical, and social factors converting a space pattern into a pattern of relationships that has the long term consequences for generations to come.

The structure of human settlements exhibits many features typical for complex networks that is common across different geographical regions, cultures, and historical epochs. We analyze the space syntax morphology by means of spectral graph theory methods.

A Model with Power-Law Distribution of Peninsula Size
(Lan Xiao, Beijing)

A new non-obvious but universal phenomenon in complex real-world networks called as peninsula phenomenon has been observed. Also, some experiment result has suggested that the proportion $f(x)$ of peninsulas with size x should obey a power-law distribution with the power-law exponent 1.913. Motivated by this experiment result, we have proposed a random graph model and proved theoretically that, in our model, the peninsula size obey the power-law distribution with exponent 3.