Archive:

Workshop on Dirichlet Forms & Stochastic Analysis 2014

Sunday 26th and Monday 27th of October 2014

This is a workshop between TU Dresden and our parters in Japan Kansai University (Osaka, Japan) and Korea Seoul National University (Seoul, South Korea). The workshop is open to colleagues from other universities. Apart from the dissemination of state-of-the-art scientific results, it aims to train advanced students and to be a platform for young researchers.

Registration: Please send a short mail to **rene.schilling (at) tu-dresden.de**
There will be a small nominal fee for tea & coffee during the breaks.

Organizer: René SCHILLING (TU Dresden), Toshihiro UEMURA (Kansai University), Panki KIM (Seoul National University)

Location: C 207, Willersbau, Zellescher Weg 12-14, Dresden
A detailed description how to find us is given here.

Workshop on Dirichlet Forms & Stochastic Analysis 2014

October 26-27, 2014
Technische Universität Dresden, Germany

Participants

Berg	Christian	U Copenhagen
Berschneider	Georg	TU Dresden
Bogdan	Krysztof	TU Wroclaw
Böttcher	Björn	TU Dresden
Chaker	Jamil	U Bielefeld
Deng	Changsong	TU Dresden
Friesen	Martin	U Bielefeld
Gairing	Jan	HU Berlin
Gerle	Fabian	U Duesseldorf
Jacob	Niels	Swansea U
Kajino	Naotaka	Kobe U
Kassmann	Moritz	U Bielefeld
Kawabi	Hiroshi	Okayama U
Keller-Ressel	Martin	TU Dresden
Kigami	Jun	Kyoto U
Kim	Kyung-Youn	Seoul National U
Kim	Panki	Seoul National U
Knopova	Victoria	TU Dresden
Koch	Malte	U Bremen
Kühn	Franziska	TU Dresden
Kumagai	Takashi	Kyoto U
Nelson	Peter	U Mainz
Neukamm	Stefan	TU Dresden
Norton	Thomas	TU Dresden
Rahantamialisoa	Tahiri	U Hannover
Sandric	Nikola	TU Dresden
Schilling	René	TU Dresden
Schwarzenberger	Michael	TU Dresden
Shin	Jiyong	Seoul National U
Shindo	Takahiro	Kansai U
Shiozawa	Yuichi	Okayama U
Song	Yan-Hong	TU Dresden
Suzuki	Kohei	Kyoto U
Sztonyk	Pawel	TU Wroclaw
Tomisaki	Matsuyo	Nara Women's U
Trutnau	Gerald	Seoul National U
Uemura	Toshihiro	Kansai U
Wang	Jian	Fujian Normal U

Workshop on Dirichlet Forms & Stochastic Analysis 2014

Sunday Oct 26th		
09.00 – 09.40	**Jun Kigami** (Kyoto)	Time change of Brownian motion: Poincare inequality and heat kernel estimate
09.45 – 10.25	**Niels Jacob** (Swansea)	Remarks on transition functions and their induced geometry
	Coffee	
10.50 – 11.30	**Yuichi Shiozawa** (Okayama)	A note on the lower escape rate of symmetric jump-diffusion processes
11.35 – 12.15	**Björn Böttcher** (Dresden)	Embedded Markov chain approxi-mations in Skorokhod topologies
	Lunch	
14.00 – 14.40	**Naotaka Kajino** (Kobe)	Spectral volume and surface measures via the Dixmier trace for local symmetric Dirichlet spaces with Weyl type eigenvalue asymptotics
14.45 – 15.25	**Jan Gairing** (Berlin)	Ergodic Theory and Lyapunov Exponents for Lévy driven Systems
	Coffee	
15.50 – 16.30	**Pawel Sztonyk** (Wroclaw)	Estimates of transition densities for jump Lévy processes
16.35 – 17.15	**Kohei Suzuki** (Kansai)	Convergence of continuous stochastic processes on compact metric spaces under the Lipschitz convergence
17.20 – 18.10	**Moritz Kassmann** (Bielefeld)	Comparability results for nonlocal symmetric Dirichlet forms
	Dinner	

Monday Oct 27th		
09.00 – 09.40	**Martin Keller-Ressel** (Dresden)	On the limit distributions of continuous-state branching processes with immigration
09.45 – 10.25	**Hiroshi Kawabi** (Okayama)	Long time behavior of non-symmetric random walks on crystal lattices
	Coffee	
10.50 – 11.30	**Gerald Trutnau** (Seoul)	On countably skewed Brownian motion with accumulation point
11.35 – 12.15	**Matsuyo Tomisaki** (Nara)	Lévy measure density corresponding to the inverse local time of harmonic transformed diffusion processes
	Lunch	
14.00 – 14.40	**Krzysztof Bogdan** (Wroclaw)	Hardy inequalities for semigroups
14.45 – 15.25	**Victoria Knopova** (Kiev)	Construction and distribution properties of some Lévy-type processes
	Coffee	
15.50 – 16.30	**Stefan Neukamm** (Dresden)	Quantitative stochastic homogenization of discrete elliptic equations with non-symmetric coefficients
16.35 – 17.15	**Jian Wang** (Fujian)	Coupling by Reflection and Hölder Regularity for Non-Local Operators of Variable Order
17.20 – 18.10	**Takashi Kumagai** (Kyoto)	Heat kernel estimates and local CLT for random walk among random conductances with a power-law tail near zero

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WORKSHOP ON DIRICHLET FORMS & STOCHASTIC ANALYSIS 2014

Sunday 26th and Monday 27th of October 2014

Arrival Information

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Schedule: List of abstracts

Sunday, October 26th

09:00-09:40	**Jun Kigami** (Kyoto U, Japan)	Time change of Brownian motion: Poincare inequality and heat kernel estimate
09:45-10:25	**Niels Jacob** (Swansea U, UK)	Remarks on transition functions and their induced geometry
	Coffee break	
10:50-11:30	**Yuichi Shiozawa** (Okayama U, Japan)	A note on the lower escape rate of symmetric jump-diffusion processes
11:35-12:15	**Björn Böttcher** (TU Dresden, Germany)	Embedded Markov chain approximations in Skorokhod topologies
	Lunch	
14:00-14:40	**Naotaka Kajino** (Kobe U, Japan)	Spectral volume and surface measures via the Dixmier trace for local symmetric Dirichlet spaces with Weyl type eigenvalue asymptotics
14:45-15:25	**Jan Gairing** (HU Berlin, Germany)	Ergodic Theory and Lyapunov Exponents for Levy driven Systems
	Coffee break	
15:50-16:30	**Pawel Sztonyk** (TU Wroclaw, Poland)	Estimates of transition densities for jump L'evy processes
16:35-17:15	**Kohei Suzuki** (Kansai U, Japan)	Convergence of continuous stochastic processes on compact metric spaces under the Lipschitz convergence
17:20-18:10	**Moritz Kassmann** (U Bielefeld, Germany)	Comparability results for nonlocal symmetric Dirichlet forms
19.00-	**Dinner**	

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09:00-09:40	**Martin Keller-Ressel** (TU Dresden, Germany)	On the limit distributions of continuous-state branching processes with immigration
09:45-10:25	**Hiroshi Kawabi** (Okayama U, Japan)	Long time behavior of non-symmetric random walks on crystal lattices
	Coffee break	
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14:45-15:25	**Victoria Knopova** (Kiev U, Ukraine)	Construction and distribution properties of some Levy-type processes
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15:50-16:30	**Stefan Neukamm** (TU Dresden, Germany)	Quantitative stochastic homogenization of discrete elliptic equations with non-symmetric coefficients
16:35-17:15	**Jian Wang** (Fujian Normal U, China)	Coupling by Reflection and Hölder Regularity for Non-Local Operators of Variable Order
17:20-18:10	**Takashi Kumagai** (RIMS Kyoto, Japan)	Heat kernel estimates and local CLT for random walk among random conductances with a power-law tail near zero

Organizers:
René Schilling (TUD)
Toshihiro Uemura (Kansai University)
Panki Kim (Seoul National University)

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Abstracts

Krzysztof Bogdan (TU Wrocław)

Hardy inequalities for semigroups

Abstract: We will discuss a general non-explosion result for Schrödinger perturbations of transition densities and Hardy inequalities for the corresponding quadratic forms. This is a joint work with Panki Kim and Bartłomiej Dyda.

Björn Böttcher (TU Dresden)

Embedded Markov chain approximations in Skorokhod topologies

Abstract: We give a unified introduction to the four Skorokhod topologies: J_1, J_2, M_1 and M_2. Based on this we discuss the convergence of various embedded Markov chains.

The talk is based on the preprint: Böttcher, B. Embedded Markov chain approximations in Skorokhod topologies, 2014, arXiv:1409.4656

Jan Gairing (HU Berlin)

Ergodic Theory and Lyapunov Exponents for Levy driven Systems

Abstract: We investigate a class of non-linear stochastic differential equations driven by Lévy processes from the view point of random dynamical systems (RDS). The identification of the solutions as a cocycle over an ergodic measurable dynamical base system that models the Lévy noise allows us to establish a "path wise" ergodic theory. The Lyapunov exponents of the linearization of the system give the exponential growth rate of perturbations of the initial condition in the specific directions given by Oseledec's celebrated Multiplicative Ergodic Theorem (MET). In this sense they measure the linear stability of the systems. Or goal is to derive a Furstenberg-Khasminskii type formula for the top Lyapunov exponent expressing the growth rate in terms of a Markovian ergodic average and the action of the infinitesimal generator.

Niels Jacob (Swansea U)

Remarks on transition functions and their induced geometry

Abstract: We will discuss geometric interpretations of kernels of one-parameter operator semi-groups as well as fundamental solutions of certain pseudo-differential operators with time-dependent coefficients. Some relations to additive processes will be mentioned.

Naotaka Kajino (Kobe U)

Spectral volume and surface measures via the Dixmier trace for local symmetric Dirichlet spaces with Weyl type eigenvalue asymptotics

Abstract: The purpose of this talk is to present the author's recent results of on an operator theoretic way of looking at Weyl type Laplacian eigenvalue asymptotics for local symmetric Dirichlet spaces.

For the Laplacian on a d-dimensional Riemannian manifold M, Connes' trace theorem implies that the linear functional $f \mapsto \mathrm{Tr}_\omega(f(-\Delta)^{-d/2})$ coincides with (a constant multiple of) the integral with respect to the Riemannian volume measure of M, which could be considered as an operator theoretic paraphrase of Weyl's Laplacian eigenvalue asymptotics. Here Tr_ω denotes a *Dixmier trace*, which is a trace functional defined on a certain ideal of compact operators on

a Hilbert space and is meaningful e.g. for compact non-negative self-adjoint operators whose n-th largest eigenvalue is comparable to $1/n$.

The first main result of this talk is an extension of this fact in the framework of a general regular symmetric Dirichlet space satisfying Weyl type asymptotics for the trace of its associated heat semigroup, which was proved for Laplacians on p.-c.f. self-simiar sets by Kigami and Lapidus in 2001 under a rather strong assumption.

Moreover, as the second main result of this talk it is also shown that, given a local regular symmetric Dirichlet space with a sub-Gaussian heat kernel upper bound and a (sufficiently regular) closed subset S, a "spectral surface measure" σ_S on S can be obtained through a similar linear functional involving the Laplacian with Dirichlet boundary condition on S. In principle, σ_S corresponds to the second order term for the eigenvalue asymptotics of this Dirichlet Laplacian, and when the second order term is explicitly known it is possible to identify σ_S. For example, in the case of the usual Laplacian on $\mathbb{R}^d$ and a Lipschitz hypersurface S, σ_S is a constant multiple of the usual surface measure on S.

Moritz Kassmann (U Bielefeld)

Comparability results for nonlocal symmetric Dirichlet forms

Abstract: In recent years, several regularity results were obtained for solutions to nonlocal equations where the integrodifferential operator is linked to a nonlocal symmetric Dirichlet form. We study the question which assumptions on the kernel are sufficient in order to prove regularity results.

Hiroshi Kawabi (Okayama U)

Long time behavior of non-symmetric random walks on crystal lattices

Abstract: In this talk, we discuss long time behavior of non-symmetric random walks on crystal lattices. In particular, we provide two kinds of weak convergence of laws of the random walks. We first show that the Brownian motion on the Euclidean space with the Albanese metric appears as the usual scaling limit of the random walk by subtracting the asymptotic direction. Next, we introduce a family of random walks which interpolates between the original (non-symmetric) random walk and the symmetric one. We then show that the Brownian motion with a constant drift on the Euclidean space also appears as the scaling limit. This talk is based on joint work with Satoshi Ishiwata (Yamagata University) and Motoko Kotani (Tohoku University).

Martin Keller-Ressel (TU Dresden)

On the limit distributions of continuous-state branching processes with immigration

Abstract: We consider the class of continuous-state branching processes with immigration (CBI-processes), introduced by Kawazu and Watanabe [1971] and their limit distributions as time tends to infinity. We determine the Levy-Khintchine triplet of the limit distribution and give an explicit description in terms of the characteristic triplet of the Levy subordinator and the scale function of the spectrally positive Levy process, which describe the immigration

resp. branching mechanism of the CBI-process. This representation allows us to describe the support of the limit distribution and characterise its absolute continuity and asymptotic behavior at the boundary of the support, generalizing several known results on self-decomposable distributions. This is joint work with Aleksandar Mijatovic (Imperial College London).

Jun Kigami (Kyoto U)

Time change of Brownian motion: Poincare inequality and heat kernel estimate

Abstract: In this talk, we will consider time changes of Brownian motions on SIerpinski carpets including the square in the Euclidean space. First we will study: When is time change possible? When do time changed process have Feller property? Then we establish Poincare inequality for reflected process and consider heat kernel estimate by using the Poincare inequality.

Victoria Knopova (Glushkov Inst. NAS Ukraine)

Construction and distribution properties of some Lévy-type processes

Abstract: Consider a pseudo-differential operator $(L, C_0^\infty(\mathbb{R}^n))$ of certain type, defined on the class of test functions. We show that L extends to the generator of a (strong) Feller semigroup. The related Markov process admits the transition probability density which posesses upper and lower estimates of certain type. We also consider several applications, in which such a form of estimates proves to be useful.

Takashi Kumagai (RIMS Kyoto)

Heat kernel estimates and local CLT for random walk among random conductances with a power-law tail near zero

Abstract: We study on-diagonal heat kernel estimates and exit time estimates for continuous time random walks (CTRWs) among i.i.d. random conductances with a power-law tail near zero. For two types of natural CTRWs, we give optimal exponents of the tail such that the behaviors are standard (i.e. similar to the random walk on the Euclidean space) above the exponents. We then establish the local CLT for the CTRWs. We will also compare our results to the recent results by Andres-Deuschel-Slowik. This talk is a joint work with O. Boukhadra (Constantine) and P. Mathieu (Marseille).

Stefan Neukamm (TU Dresden)

Quantitative stochastic homogenization of discrete elliptic equations with non-symmetric coefficients

Abstract:

Yuichi Shiozawa (Okayama U)

A note on the lower escape rate of symmetric jump-diffusion processes

Abstract: We establish an integral test on the lower escape rate of symmetric jump-diffusion processes generated by regular Dirichlet forms. Using this test, we can find the speed of particles escaping to infinity. We apply this test to symmetric jump processes of variable order. We also derive the upper and

lower escape rates of time changed processes by using those of underlying processes.

Kohei Suzuki (Kansai U)

Convergence of continuous stochastic processes on compact metric spaces under the Lipschitz convergence

Abstract: The motivation in this talk is to formulate a convergence of continuous stochastic processes on compact metric spaces converging in the Lipschitz distance. We introduce *a Lipschitz–Prokhorov distance* d_{LP} on the set $\mathcal{PM}$ of isomorphism classes of pairs (X, P) where X is a compact metric space and P is the law of a continuous stochastic process on X. The metric d_{LP} is a kind of mixture of the Lipschitz distance and the Prokhorov distance. We show that $(\mathcal{PM}, d_{LP})$ is a complete metric space. We give a sufficient condition for relative compactness of subsets consisting of Riemannian manifolds and Markov processes. We also give a sufficient condition for sequences in such relatively compact subsets to be convergent without taking subsequences in terms of the Mosco convergence introduced by Kuwae–Shioya '03.

Pawel Sztonyk (TU Wrocław)

Estimates of transition densities for jump L'evy processes

Abstract: We give upper and lower estimates of densities of convolution semigroups of probability measures under explicit assumptions on the corresponding Lévy measure (non-necessarily symmetric and absolutely continuous with respect to the Lebesgue measure) and the Lévy–Khinchin exponent. We obtain also estimates of derivatives of densities.

Furthermore, for a large class of Lévy measures, including those with jumping kernels exponentially and subexponentially localized at infinity, we find the optimal in time and space upper bound for the corresponding transition kernels at infinity. In case of Lévy measures that are symmetric and absolutely continuous, with densities g such that $g(x) \asymp f(|x|)$ for nonincreasing profile functions f, we also prove the full characterization of the sharp two-sided transition densities bounds of the form

$$p_t(x) \asymp h(t)^{-d} \cdot \mathbf{1}_{|x|\le\theta h(t)} + t\, g(x) \cdot \mathbf{1}_{|x|\ge\theta h(t)}, \quad t \in (0, t_0), \quad t_0 > 0, \quad x \in \mathbf{R}^d.$$

This is done for small and large x separately. Mainly, our argument is based on new precise upper bounds for convolutions of Lévy measures. Our investigations lead to some interesting and surprising dichotomy of the decay properties at infinity for transition kernels of purely jump Lévy processes.

The joint work with Kamil Kaleta.

Matsuyo Tomisaki (Nara Womens' U)

Lévy measure density corresponding to the inverse local time of harmonic transformed diffusion processes

Abstract: (joint work with T. Takemura) Let $\mathcal{G}_{s,m,k}$ be a one-dimensional diffusion operator on $I = (l_1, l_2)$ with scale function s, speed measure m, and killing measure k, where $-\infty \le l_1 < l_2 \le \infty$. Let $\mathbb{D}_{s,m,k}$ be the one-dimensional

diffusion process on $I = (l_1, l_2)$ with generator $\mathcal{G}_{s,m,k}$. We consider the the harmonic transform $\mathbb{D}_{s_h,m_h,0}$ based on a harmonic function h. Assume that l_1 is $(s_h, m_h, 0)$-regular and pose the reflecting boundary condition at l_1. We denote by $\mathbb{D}^*_{s_h,m_h,0} = [X(t); P^*_{(h),x}]$ the corresponding diffusion process, and denote by $\tau^*_{(h)}(t)$ the inverse local time at the end point l_1. Then we have the following representation.

$$E^*_{(h),l_1}\left[e^{-\lambda\tau^*_{(h)}(t)}\right] = \exp\left\{-\gamma^*_{(h)}t - t\int_0^\infty (1-e^{-\lambda\xi})n^*_{(h)}(\xi)\,d\,\xi\right\},$$

where $\gamma^*_{(h)}$ is a nonnegative number and $n^*_{(h)}(\xi)$ is a Lévy measure density given by some quantities related to the original $\mathbb{D}_{s,m,k}$. Further we derive the asymptotic behavior of $n^*_{(h)}(\xi)$ as $\xi \to \infty$ from that of the original speed measure $m(x)$ as $x \to l_2$, and show that the asymptotic behavior of $n^*_{(h)}(\xi)$ as $\xi \to \infty$ is independent of that of harmonic function h.

Gerald Trutnau (Seoul National U)

On countably skewed Brownian motion with accumulation point

Abstract: Countably skewed Brownian motion (CSBM) is a special case of distorted Brownian motion in dimension one. Existence and pathwise uniqueness of CSBM was presented by Le Gall in 1984 in an abstract frame for some special cases and then explicitly presented by Takanobu in 1986 assuming a uniform, strictly positive distance between the skew reflection points. In this case CSBM is a semimartingale and conservative, i.e. without explosion in finite time. This is not the case when the sequence of skew reflection points has an accumulation point. In this case we shall discuss conditions for existence, pathwise uniqueness, non-explosion, recurrence and positive recurrence, and conditions for CSBM to be a semimartingale. We shall also consider applications. (This is joint work with Youssef Ouknine (Cadi Ayyad University Marrakech) and Francesco Russo (ENSTA ParisTech)).

Jian Wang (Fujian Normal U)

Coupling by Reflection and Hölder Regularity for Non-Local Operators of Variable Order

Abstract: We consider the non-local operator of variable order as follows

$$Lf(x) = \int_{\mathbb{R}^d\setminus\{0\}} \big(f(x+z) - f(x) - \langle\nabla f(x), z\rangle \mathbf{1}_{\{|z|\le 1\}}\big)\frac{n(x,z)}{|z|^{d+\alpha(x)}}\,dz,$$

where $\alpha(x) \in [\alpha_0, \alpha_2]$ for any $x \in \mathbb{R}^d$ and some constants $0 < \alpha_0 \le \alpha_2 < 2$, and $n(x,z)$ is a positive Borel measurable function bounded from above and below. Under mild continuous conditions on $\alpha(x)$ and $n(x,z)$, we establish the Hölder regularity for the associated semigroups. The proof is based on a new construction of the coupling by reflection for non-local operator L, and the results successfully apply to both stable-like processes in the sense of Bass and time-change of symmetric stable processes.