Institut für Mathematik

Lehrstühle für Wahrscheinlichkeitstheorie und Statistik

Forschungsseminar : Stochastic Analysis

Wintersemester 2019-20, montags 12:15-13:45, Campus Golm, Haus 9 Raum 2.22

14.10.19 Dr. **Pierre Houdebert** (Potsdam):

Phase transition of Gibbs point processes using Fortuin-Kasteleyn representation

The Fortuin-Kasteleyen representation, introduce in the '60s, is a method used to prove phase transition for Gibbs point process. It reduces the problem of phase transition to the study of connectivity in an underlying universal point process. It as been used to prove phase transition for several discrete models (Ising model, Potts model, ...) and continuum model (Widom-Rowlinson model, area interaction) and I will present it in the context of the non-symmetric continuum Potts model which is the first continuum model for which the FK representation was used in the non-symmetric case.

21.10.19 **Enrico Reiß** (Potsdam):

Weyl asymptotics for discrete Hamiltonians on a scaled lattice

In mean field theories of statistical mechanics where N particles interact, macroscopic observables typically take values in a scaled lattice with lattice spacing 1/N. An easy but typical example is the magnetization in the Curie-Weiss model (which is one-dimensional). Time evolution in these models can be described by a reversible Markov chain in discrete time, with transition matrix P. Then 1 - P is analog to a self-adjoint infinitesimal generator, or in physical language to the Hamilton operator of the system.

After h-transform with respect to the reversible measure one has transformed to a space with counting measure. Hilbert space theory on this space can be written down by use of Fourier transform, which allows to realize these Hamilton operators as special pseudodifferential operators where each operator arises from a symbol on phase space by quantization.

We show that in the limit "N to infty" (corresponding to lattice spacing tending to zero) the sharp Weyl estimates for the number of eigenvalues inside a compact interval extend from the continuous setting to the discrete setting (under appropriate assumptions). In particular, the leading term is a phase space volume.

04.11.19 **Franziska Göbel** (Potsdam):

Multiscale statistical analysis on random geometric graphs

In this talk I will present a multiscale approach to construct a data-adapted basis-like (Parseval frame) set of functions F which allows for a decomposition of every square-integrable function defined on the vertices of a finite undirected weighted graph. We have a look at some properties of F and at its application in the denoising setup which is based on the property of being a Parseval frame. Related to the property of spatial localization we furthermore show that the considered random neighborhood graphs satisfy with high probability a doubling volume condition as well as a local Poincaré inequality under some assumptions on the underlying space and the sampling.

11.11.19 Dr. **Sara Mazzonetto** (Potsdam):

A nonlinear integration by parts formula for stochastic differential equations

In this talk we introduce a nonlinear integration-by-parts formula for stochastic differential equations. We call it *Itô-Alekseev-Gröbner formula* because it generalizes both Itô formula and the classical Alekseev-Gröbner lemma for deterministic differential equations. We focus on the fact that the formula yields a (new) *perturbation theory*. In other words, it allows to estimate the global error between the exact solution of an SDE and a general Itô process in terms of the local characteristics (and their Malliavin derivatives).
In the result we assume the existence of a *twice differentiable flow*. How restrictive is this assumption? If time permits we also discuss possible applications for deriving strong convergence rates for perturbations or approximations of stochastic (partial) differential equations.
This talk is based on joint works with A. Hudde, M. Hutzenthaler, and A. Jentzen.

18.11.19 Dr. **Olga Aryasova** (Kyiv):

On diffusion processes in Euclidean space with intersecting membranes

We consider an Euclidean space with semipermeable membranes on nonsmooth surfaces, for example, on the boundary of a wedge or a cone. We study the existence and uniqueness of a strong Markov process with continuous sample paths which behaves like a diffusion with given coefficients out of membranes and partially reflected on them. The question of hitting irregular points of the membranes (for instance, the vertex of a wedge) by the process plays a key role in our investigation. Besides, this problem is interesting itself.

25.11.19 Dr. **Han Chen Lie** (Potsdam):

Frechet differentiable drift dependence of Perron-Frobenius and Koopman operators for stochastic dynamical systems

Global long-term properties of dynamical systems, such as their stationary distribution or rate of mixing, are strongly related to spectral objects of certain operators. These operators, which are known as `transfer operators', describe the evolution of distributions and observables under nonlinear, stochastic dynamics. In this talk, we shall show that for diffusion processes defined by stochastic differential equations (SDEs) in bounded domains with reflecting boundary conditions, these operators depend in a smooth (Frechet) way on the drift coefficient of the SDE. We describe how these smoothness properties carry over to isolated eigenvalues of the transfer operators and the corresponding eigenfunctions.

09.12.19 Dr. **Sandra Kliem** (Frankfurt):

The one-dimensional contact process and the KPP equation with noise

The one-dimensional KPP-equation driven by space-time white noise,

$$\partial_t u = \partial_{xx} u + \theta u - u^2 + u^{1/2} dW, t>0, x\in\mathbb{R}, \theta>0, u(0,x)=u_0(x)\geq 0$$

is a stochastic partial differential equation (SPDE) that exhibits a phase transition for initial non-negative finite-mass conditions. Solutions to this SPDE arise for instance as (weak) limits of approximate densities of occupied sites in rescaled one-dimensional long range contact processes.

If θ is below a critical value θ_c, solutions with initial finite mass die out to 0 in finite time, almost surely. Above this critical value, the probability of (global) survival is strictly positive. Let $\theta>\theta_c$, then there exist stochastic wavelike solutions which travel with non-negative linear speed. For initial conditions that are 'uniformly distributed in space', the corresponding solutions are all in the domain of attraction of a unique non-zero stationary distribution.

For the (parameter-dependent) nearest-neighbor contact process on $\mathbb{Z}$, an interacting particle system, more is known. A complete convergence theorem holds, that is, a full description of the limiting law of a solution is available, starting from any initial condition. Its proof relies in essence on the progression of so-called edge processes. In these models, edge speeds characterize critical values.

In my talk, I will introduce the two models in question (nearest-neighbor contact process and KPP-equation with noise). Then I explain in how far the concepts and techniques of the first model can be used to obtain new insights into the second model. In particular, the problems one encounters when changing from the discrete to the continuous (in space) setting are highlighted and approaches to resolve them are discussed.

16.12.19 Prof. Dr. **Michael Högele** (Bogotà, Colombia):

The first passage problem for stable linear delay equations perturbed by small power law Lévy noise

In this talk we present a linear scalar delay differential equation subject to small multiplicative power tail Lévy noise. We solve the first passage (the Kramers) problem with probabilistic methods and discover an asymptotic loss of memory in this non-Markovian system. Furthermore, the mean exit time increases as the power of the small noise amplitude, whereas the pre-factor accounts for memory effects. In particular, we discover a non-linear delay-induced exit acceleration due to a non-normal growth phenomenon. Our results are illustrated for the linear delay oscillator driven by alpha-stable Lévy flights. This is joint work with I. Pavlyukevich.

13.01.20 Dr. **András J. Tóbiás** (TU Berlin):

A Gibbsian model for message routeing in highly dense multihop networks

We investigate a probabilistic model for routeing of messages in relay-augmented multihop ad-hoc networks, where each transmitter sends one message to the origin. Given the (random) transmitter locations, we weight the family of random, uniformly distributed message trajectories by an exponential probability weight, favouring trajectories with low interference (measured in terms of signal-to-interference ratio) and trajectory families with little congestion (measured in terms of the number of pairs of hops using the same relay). Under the resulting Gibbs distribution, the system targets the best compromise between entropy, interference, and congestion for a common welfare, instead of an optimization of the individual trajectories.

In the limit of high spatial density of users, we describe the totality of all the message trajectories in terms of empirical measures. Employing large deviations arguments, we derive a characteristic variational formula for the limiting free energy and analyse the minimizer of the formula, which describes the most likely shape of the trajectory flow. The empirical measures of the message trajectories well describe the interference, but not the congestion; the latter requires introducing an additional empirical measure. Our results remain valid under replacing the two penalization terms with more general functionals of these two empirical measures. We also analyse qualitative properties of the minimizer in the special case when congestion is not penalized.

20.01.20 **Oleksandr Zadorozhnyi** (Universität Potsdam):

Stochastic dependent bandits with memory

In the talk I present the stochastic multi-armed bandit problem and its analysis in the case when the arm samples are dependent over time and generated from the so-called weak *C*-mixing process. Then I present the *C*-Mix Improved UCB agorithm and provide both problem-dependent and independent regret analysis in two different scenarios. In the first, so-called fast-mixing scenario, the pseudo-regret enjoys the same upper bound (up to a factor) as for independent observations; whereas in the second, slow mixing scenario, we discover a surprising effect, that the regret upper bound is similar to the independent case, with an incremental *additive* term which does not depend on the number of arms. The analysis of slow mixing scenario is supported with a minmax lower bound, which (up to a log(T) factor) matches the obtained upper bound. The talk is based on the joint work with Gilles Blanchard and Alexandra Carpentier.

27.01.20 Prof. Dr. **Andrey Pilipenko** (Kyiv):

On the maximum of a perturbed random walk

Let $(\xi_1,\eta_1),(\xi_2,\eta_2),\ldots$ be asequence of i.i.d. two-dimensional random vectors. We prove a functional limit theorem for the maximum of a perturbed random walk $max_{0\le k\le n}(\xi_1+\ldots+\xi_k+\eta_{k+1})$ in a situation where its asymptotics is affected by both $max_{0\le k\le n}(\xi_1+\ldots+\xi_k)$ and $max_{0\le k\le n}\eta_k$ to a comparable extent.

The talk is based on the joint work with A.Iksanov and I.Samoilenko.

Interessenten sind herzlich eingeladen !

Sara Mazzonetto.