Spring School
Selected topics in stochastic geometry
February 25 – March 1, 2019
TU Darmstadt

Short Courses
Zakhar Kabluchko
Joseph E. Yukich

Invited Speakers
Daniel Hug
Joscha Prochno
Matthias Reitzner
Matthias Schulte
Christoph Thäle

Organization
Frank Aurzada
Volker Betz
Matthias Meiners

Contents

1 General Information

1.1 Accommodation

The participants are recommended to stay in one of the following hotels, located in walking distance (15 minutes) to the lecture venue.

- HOTEL WELCOME
  Karolinenplatz 4, 64289 Darmstadt
  Tel: +49-6151-3914
  info.dar@welcome-hotels.com

- HOTEL ATLANTA
  Kasinostraße 129, 64293 Darmstadt
  Tel: +49-6151-1789-0
  info@hotel-atlanta-darmstadt.de

For directions please see the map on the back cover.

1.2 Registration

On Monday morning, starting from 8:00, registration is possible in the lobby of the lecture hall.

1.3 Lecture Hall

Location: Technische Universität Darmstadt. The registration and all lectures will take place in building S2|07, Hochschulstraße 6, 64289 Darmstadt in lecture hall S2|07/167. In the lecture hall, there are 2 large blackboards and a projector.

1.4 Map & Points of Interest

The map can be found on the back cover.

1.5 Public Transportation

The closest bus and tram stops to the venue of the workshop are **Schloss** (trams: S2, S3, S9) and **Willy-Brandt-Platz** (trams: S4, S5, S6, S7, S8). Both stops are within 10 minutes walking distance to the lecture hall.

1.6 Food & Beverage

Cheap and plain food can be purchased at the TU Darmstadt Refectory-Canteen, Alexanderstr. 4, building S1|11, Monday to Friday 11:15 to 14:00. Additionally there are lots of good restaurants and bistros near TU Darmstadt. Please dial +49 6151 preceding the number given below.

Name	Address	Phone	Cuisine	Opening Hours
Ratskeller	Marktplatz 8	26444	German	10:00 - 01:00
Pizzeria da Nino	Alexanderstr. 29	24220	Italian	18:00 - 23:00
Haroun's	Friedensplatz 6	23487	Oriental	11:00 - 22:30
Vis à Vis	Fuhrmannstr. 2	8058339	Bistro	12:00 - 15:00
Cafe Extrablatt	Marktplatz 11	5998820	Bistro	08:30 - 23:30
Ristorante Sardegna	Kahlertstraße 1	23029	Italian	11:30 - 14:45

1.7 Conference Dinner

On Tuesday, February 26th, there will be a conference dinner at the Restaurant Ratskeller, Marktplatz 8, 64283 Darmstadt, Phone: +49 6151 - 26444, info@ratskeller-darmstadt.de.

1.8 Free Afternoon

On Wednesday, February 27th, there will be a free afternoon.

1.9 Contact Information

If you have any questions concerning the workshop, please feel free to contact one of the local organizers or the technical support:

- Prof. Dr. Frank Aurzada
  Office: S2-15, Room 341
  Phone: +49 6151 - 16 23375
- Prof. Dr. Volker Betz
  Office: S2-15, Room 340
  Phone: +49 6151 - 16 23370
- Office Department
  Office: S2-15, Room 339
  Phone:+49 6151 - 16 23380 or - 16 23378

Acknowledgements

Financial support by the Universität Innsbruck and the Department of Mathematics at Technische Universität Darmstadt is acknowledged.

Programme

Time	Monday	Tuesday	Wednesday	Thursday	Friday
08:00	Registration				
09:00	Yukich	Yukich	Yukich	Yukich	Kabluchko
	Coffee break	*Coffee break*	*Coffee break*	*Coffee break*	*Coffee break*
11:00	Kabluchko	Kabluchko	Kabluchko	Kabluchko	Invited talk: Prochno
	Lunch	*Lunch*	*Coffee break*	*Lunch*	12:00 Contr. talks: Hirsch Okamura
14:00	Invited talk: Reitzner	Yukich	12:30 Invited talk: Schulte	Invited talk: Hug	
	Contr. talk: Winter		*Lunch*	Contr. talk: Marynych	*Lunch*
	Coffee break	*Coffee break*	*Free Afternoon* *Excursion*	*Coffee break*	*End of Workshop*
16:00	Short talks: Flimmel Fenzl Tóbiás von Loeper Smii	Invited talk: Thäle		Short talks: Schickentanz Neumann Seidel Schmid Jendoubi	
	Reception	Dinner			

Monday, 25 February 2019

Time	Speaker	*Title of Talk*
09:00-09:05	Welcome	
09:05-10:35	Joseph Yukich	*Mini course: Probabilistic Analysis of Geometric Structures*
10:35-11:00		–Coffee break–
11:00-12:30	Zakhar Kabluchko	*Mini course: Random polytopes*
12:30-14:00		–Lunch break–
14:00-15:00	*Invited talk* Matthias Reitzner	 *Empty simplices*
15:00-15:30	*Contributed talk* Steffen Winter	 *Geometric functionals of fractal percolation*
15:30-16:00		–Coffee break–
16:00-16:10	Short talk	Daniela Flimmel
16:10-16:20	Short talk	Marcel Fenzl
16:20-16:30	Short talk	András Tóbiás
16:30-16:40	Short talk	Freimut von Loeper
16:40-16:50	Short talk	Boubaker Smii
17:00-23:00	Reception	–Cheese & Wine–

Tuesday, 26 February 2019

Time	Speaker	*Title of Talk*
09:00-10:30	Joseph Yukich	*Mini course: Probabilistic Analysis of Geometric Structures*
10:30-11:00		–Coffee break–
11:00-12:30	Zakhar Kabluchko	*Mini course: Random polytopes*
12:30-14:00		–Lunch break–
14:00-15:30	Joseph Yukich	*Mini course: Probabilistic Analysis of Geometric Structures*
15:30-16:00		–Coffee break–
16:00-17:00	*Invited talk* Christoph Thäle	*Geometry of iteration stable tessellations*
18:30-22:00	Conference Dinner	–Restaurant Ratskeller–

Wednesday, 27 February 2019

Time	Speaker	*Title of Talk*
09:00-10:30	Joseph Yukich	*Mini course: Probabilistic Analysis of Geometric Structures*
10:30-10:45		–Coffee break–
10:45-12:15	Zakhar Kabluchko	*Mini course: Random polytopes*
12:15-12:30		–Coffee break–
12:30-13:30	*Invited talk*	
	Matthias Schulte	*Component counts in the random connection model*
13:30-14:30		–Lunch break–
		–Free Afternoon – Excursion–

Thursday, 28 February 2019

Time	Speaker	*Title of Talk*
09:00-10:30	Joseph Yukich	*Mini course: Probabilistic Analysis of Geometric Structures*
10:30-11:00		–Coffee break–
11:00-12:30	Zakhar Kabluchko	*Mini course: Random polytopes*
12:30-14:00		–Lunch break–
14:00-15:00	*Invited talk* Daniel Hug	*Splitting tessellations in spherical space*
15:00-15:30	*Contributed talk* Alexander Marynych	*Sieving random iterative function systems*
15:30-16:00		–Coffee break–
16:00-16:10	Short talk	Dominic T. Schickentanz
16:10-16:20	Short talk	Matthias Neumann
16:20-16:30	Short talk	Hauke Seidel
16:30-16:40	Short talk	Dominik Schmid
16:40-16:50	Short talk	Souheyl Jendoudi

Friday, 1 March 2019

Time	Speaker	*Title of Talk*
09:00-10:30	Zakhar Kabluchko	*Mini course: Random polytopes*
10:30-11:00		–Coffee break–
11:00-12:00	*Invited talk*	
	Joscha Prochno	*Asymptotic shape of random polytopes*
12:00-12:30	*Contributed talk*	
	Christian Hirsch	*Functional CLTs for persistent Betti numbers*
12:30-13:00	*Contributed talk*	
	Kazuki Okamura	*Bi-infinite geodesics of first passage percolation on some infinite graphs*
13:00-14:30		–Lunch break, End of the Spring School–

2 List of Talks

2.1 Short Courses

Zakhar Kabluchko
Universität Münster, Germany
Mini course: Random polytopes

A polytope is a convex hull of finitely many points in Euclidean space. By taking these points to be random, we obtain random polytopes. Examples include convex hulls of independent identically distributed random points (including the so-called Gaussian polytope which arises if the points have standard Gaussian distribution), convex hulls of multidimensional random walks, random projections of regular polytopes, and many others. We shall be interested in computing expectations of various functionals of such polytopes, for example the volume, the number of faces, internal and external solid angles, and some others. It turns out that there are many beautiful interrelations between these functionals. For example, Baryshnikov and Vitale observed that the number of faces has the same distribution for Gaussian polytopes as for projections of regular polytopes. The main tool used in our computations is the integral geometry of convex cones. We shall introduce the participants to this subject. In particular, we shall give various definitions of intrinsic volumes for convex cones. Also, we shall address some problems of classical geometry. For example, we shall compute the number of parts in which n affine or linear hyperplanes in general position divide the d-dimensional space. Surprisingly, this problem is equivalent to the following one: compute the probability that the Gaussian polytope contains the origin. We shall try to stress interconnections between the conic integral geometry and various other subjects such as random matrices, the classical Sparre Andersen arcsine laws for random walks, and the high-dimensional statistics.

Joseph Yukich
Lehigh University, Pennsylvania
Mini course: Probabilistic Analysis of Geometric Structures

Many questions arising in stochastic geometry and applied probability, as well as in random graphs, spatial statistics, and statistical physics, may be understood in terms of the behavior of statistics of large random geometric structures. Here the randomness often comes from an underlying point process, i.e., a random collection of points in $\mathbb{R}^d$, and the structure is generated from the underlying point process and heavily depends on the geometry of the points. Examples for such structures are random graphs such as nearest neighbor graphs where the vertices are the points of a point process and edges are drawn according to deterministic rules that take the geometry of the points into account, random polytopes generated as convex hulls of the underlying point process, or random tessellations such as Voronoi tessellations. Models and structures of this type are used in physics, materials science, telecommunications, and statistics of large data sets. This course will survey methods for establishing the limit theory of statistics of geometric structures. The five lectures will focus on classical sub-additive methods as well as more recent stabilization methods. The latter tool allows one to study statistics which may be expressed as a sum of spatially dependent terms having short range interactions but complicated long range dependence.

- Lecture 1: Probabilistic analysis of Euclidean optimization problems
- Lecture 2: Central limit theorems for statistics of geometric structures
- Lecture 3: Limit theory for statistics of geometric structures via stabilizing score functions
- Lecture 4: Statistics of random polytopes
- Lecture 5: Rates of multivariate normal approximation for statistics of geometric structures

2.2 Invited Speakers

Daniel Hug
Splitting tessellations in spherical space
Karlsruhe Institute of Technology, Germany

We introduce and explore the concept of splitting tessellations and splitting tessellation processes in spherical spaces. Expectations, variances and covariances of spherical curvature measures induced by a splitting tessellation will be studied with the help of tools from spherical integral geometry. Also the spherical pair-correlation function of the $(d-1)$ - dimensional Hausdorff measure will be computed explicitly and compared to its analogue for Poisson great hypersphere tessellations. Finally, we explain how the typical cell distribution and the distribution of the typical spherical maximal face of any dimension can be expressed as mixtures of the related distributions of Poisson great hypersphere tessellations. This in turn is used to determine the expected length and the precise birth time distribution of the typical maximal spherical segment of a splitting tessellation.

Joscha Prochno
Asymptotic shape of random polytopes
Universität Graz, Austria

We give a very brief introduction to random polytopes and their geometric aspects within the framework of asymptotic geometric analysis. The model we are looking at is as follows: we sample random points $X_1, \dots, X_N$ independently and uniformly inside an isotropic convex body $K \subseteq \mathbb{R}^n (N \geq n)$ and consider their absolute convex hull $K_N = \mathrm{conv}\{\pm X_1, \dots, \pm X_N\}$. The latter is a random convex set in $\mathbb{R}^n$, called a random polytope, and the goal is to understand its typical asymptotic shape. Given the time constraints in this spring school, we will focus on the expected mean width of a random polytope only and prove/present optimal bounds up to absolute constants. In the regime $N \geq n^{1+\delta}$ $(\delta > 0)$ these beautiful results are due to Dafnis, Giannopoulos and Tsolomitis (actually they considered the whole sequence of Minkowski integrals and obtained results with high-probability as well). When the number of points is linear in the dimension, that is, when $N \approx n$, the optimal bound was proved by Alonso-Gutierrez and Prochno (but we shall not discuss this case here).

Matthias Reitzner
Empty simplices
Universität Osnabrück, Germany

Consider an n-element point set in general position in d-dimensional space. For a k-element subset the degree is the number of empty simplices with this k-set as base. The k-degree of the n-element set is defined as the maximum degree over all k-element subset. We investigate the degree of random point sets consisting of n independently and uniformly chosen points from a compact set.

Matthias Schulte
Component counts in the random connection model
Universität Bern, Switzerland

The random connection model is a spatial random graph, whose vertices are the points of a stationary Poisson point process in Euclidean space. Each pair of distinct vertices x, y is independently connected by an edge with a probability depending on the relative position of x and y (for example, their distance). This model generalises the random geometric graph, where the probability for drawing an edge is one if the distance does not exceed a given threshold and zero otherwise. In this talk, the numbers of components of the random connection model which are isomorphic to given finite connected graphs and belong to a compact convex observation window are considered. An example for such component counts is the number of isolated vertices. The total number of components within the observation window is studied as well. For increasing observation windows variance and covariance asymptotics and central limit theorems are shown. The proofs rest upon new bounds for the normal approximation of functionals of pairwise marked Poisson point processes, which are derived via the Malliavin-Stein method and might be of independent interest. This is based on joint work with Günter Last and Franz Nestmann (both Karlsruhe).

Christoph Thäle
Geometry of iteration stable tessellations
Universität Bochum, Germany

We will introduce the concept of iteration stable (STIT) tessellation in Euclidean spaces. We will interpret them as random closed sets and discuss first- and second-order properties using martingale techniques and tolls from integral geometry. We also indicate the limit theory for such tessellations, which shows Gaussian fluctuations in dimension 2 and non-Gaussian fluctuations for all higher space dimensions.

2.3 Further Speakers

Marcel Fenzl
Asymptotic results for the infinite Ginibre point process
Universität Zürich, Switzerland

The infinite Ginibre point process is one of the most important determinantal point processes on the complex plain. It arises, for example, as the limiting point process of eigenvalues of random matrices with independent, complex Gaussian entries. Using the framework of mod-phi convergence we derive precise asymptotic results for the number of its points in a growing disc. We also discuss a functional central limit theorem for the number of its points in discs considered at different large radii both in a microscopic and macroscopic regime. Joint work with Gaultier Lambert.

Daniela Flimmel
Central limit theorem for an unbiased estimator of cell characteristics of Laguerre and Johnson–Mehl tessellations
Charles University in Prague, Czech Republic

Let $\mathscr{X}$ be a random tessellation of any type, i.e. a family of closed compact subsets of $\mathbb{R}^d$ with disjoint interiors, covering the whole space. Usually, we are able to observe a realization of the tessellation only in some bounded window W. One option is to choose a suitable functional $H(\mathscr{X})$ and observe its values as the observation window increases. One natural approach is to study a functional of the the form of sum of local contributions

$$H(\mathscr{X}) = \sum_{K \in \mathscr{X}} \xi(K, \mathscr{X}) \mathbf{1}\{K \subset W\},$$

where ξ are different test functions called scores (chosen so that the sum makes sense). This statistics may disregard the edge effects caused by observing a realization in a bounded window. One possibility how to treat the edge effects is the minus sampling, i.e. we upgrade the summands by the following weights,

$$H'(\mathscr{X}) = \sum_{K \in \mathscr{X}} \frac{|W|}{|W \ominus K|} \xi(K, \mathscr{X}) \mathbf{1}\{K \subset W\},$$

where $W \ominus K = \{x \in \mathbb{R}^d : K + x \subset W\}$ and $|A|$ stands for the Lebesgue measure of A. Many asymptotic results were shown for the this type of statistics for Poisson–Voronoi tessellation. Under the same Poisson setting, we show some extension to more flexible Laguerre and Johnson–Mehl models using the stabilization method.

Christian Hirsch
Functional CLTs for persistent Betti numbers
Universität Mannheim, Germany

Persistent Betti numbers form a key tool in topological data analysis as they track the appearance and disappearance of topological features in a sample. In a two-dimensional germ-grain model with dynamically growing disks around the germs, they describe the evolution of connected components and loops.

In this talk, we present a functional CLT for persistent Betti numbers induced by point processes with fast decay of correlations when tracking features only up to a bounded size. The proof is based on methods from a recently developed framework for CLTs on point processes with fast decay of correlations (Blaszczyszyn, Yogeshwaran & Yukich, 2019+) and a refined cumulant estimate to establish tightness. We discuss possible extensions to higher dimensions and features of unbounded size. This talk is based on ongoing work with Nicolas Chenavier, Christophe Biscio and Anne Marie Svane.

Souheyl Jendoubi
Hyperbolic Ornstein-Uhlenbeck process in the Poincaré disc
Kairouan University, Tunesia

Abstract: TBA

Alexander V. Marynych
Sieving random iterative function systems
Taras Shevchenko National University of Kyiv, Ukraine

Let $\mathcal{G}$ be the space of Lipschitz functions $f : \mathbb{R}^d \mapsto \mathbb{R}^d$ endowed with the usual Lipschitz norm

$$||f||_{Lip} := |f(0)| + L_f, \quad L_f := \sup_{x,y\in\mathbb{R}^d, x\neq y} \frac{|f(y)-f(x)|}{|x-y|}, \quad f \in \mathcal{G}.$$

The composition of functions $f \circ g$ defined by $(f \circ g)(x) = f(g(x))$ for $x \in \mathbb{R}^d$ endows $\mathcal{G}$ with the semigroup structure and is continuous with respect to $||\cdot||_{Lip}$. Equip $\mathcal{G}$ with a probability measure ν on the Borel σ-algebra of $\mathcal{G}$. Furthermore, let $(\mathcal{X}, \mathcal{B}(\mathcal{X}), \mu)$ be a topological space with Borel σ-algebra and equipped with a σ-finite measure μ.
Let $\mathbb{R}_+ = [0, \infty)$ be the positive half-line with the Lebesgue measure $\mathbb{LEB}$. Consider a Poisson process $\{(t_i, x_i, f_i), i \geq 1\}$ on $\mathbb{R}_+ \times \mathcal{X} \times \mathcal{G}$ with intensity measure

$\mathbb{LEB} \otimes \mu \otimes \nu$. Note that $\{f_i, i \geq 1\}$ may be considered as independent marks of the points $\{(t_i, x_i), i \geq 1\}$ and ν is the probability distribution of a typical mark. For each Borel $A \subset \mathscr{X}$ with $\mu(A) \in (0, \infty)$, assume that the points $\{(t_{i_k}, x_{i_k}, f_{i_k}) : x_{i_k} \in A, k \geq 1\}$ are enumerated, so that the first component is increasing, and define *the backward iterations* of $\{f_{i_k} : k \geq 1\}$:

$$\zeta_n(A) = f_{i_1} \circ \cdots \circ f_{i_n}(z), \tag{2.1}$$

where $z \in \mathbb{R}^d$ is fixed. If

$$\mathbb{E} L_{f_{i_1}} = \int_{\mathscr{G}} L_{f_{i_1}} \, \mathrm{d}\nu < \infty, \quad \mathbb{E} \log L_{f_{i_1}} = \int_{\mathscr{G}} \log L_{f_{i_1}} \, \mathrm{d}\nu < 0, \tag{2.2}$$

where $L_{f_{i_1}}$ is the Lipschitz constant of f_{i_1}, and

$$\mathbb{E}|f_{i_1}(z_0) - z_0| = \int_{\mathscr{G}} |f_{i_1}(z_0) - z_0| \mathrm{d}\nu < \infty \tag{2.3}$$

for some $z_0 \in \mathbb{R}^d$, then $\zeta_n(A)$ in (2.1) converges almost surely; the limiting random element is denoted by $\zeta(A)$ and is a random set function on $\mathscr{X}$. In this talk we shall discuss properties of the random set function $\zeta(\cdot)$. We will also consider a number of important particular cases:

- perpetuities, where $f(x) = Ax + B$ and A, B are random;
- Lindley-type recursions, where $f(x) = (x + A)^+$ and A is random;
- random fractals, where f is a random Lipschitz function on the set of closed subsets of $\mathbb{R}^d$.

The talk is based on a recent joint work with I. Molchanov (Bern, Switzerland).

Matthias Neumann
Estimation of geodesic tortuosity and constrictivity in stationary random closed sets
Universität Ulm, Germany

We investigate the problem of estimating geodesic tortuosity and constrictivity as two structural char- acteristics of stationary random closed sets. They are of central importance for the analysis of effective transport properties in porous or composite materials. Loosely speaking, geodesic tortuosity measures the windedness of paths whereas the notion of constrictivity captures the appearance of bottlenecks re- sulting from narrow passages within a given materials phase. We first provide mathematically precise definitions of these quantities and introduce appropriate estimators. Then, we show strong consistency of these estimators for unboundedly growing sampling windows. In order to apply our estimators to real datasets, the extent of edge effects needs to be controlled. This is illustrated using a model for a multi-phase material that is incorporated in solid oxid fuel cells (SOFC).

Kazuki Okamura
Bi-infinite geodesics of first passage percolation on some infinite graphs
Shinshu University, Japan

We consider the first passage percolation (FPP) on some infinite graphs. Recently, Benjamini and Tessera (2016) showed that if an infinite connected simple graph has a Morse bi-infinite geodesic, then, under some conditions for the distribution of the weight, there exists a bi-infinite geodesic a.s. Their result is applicable to hyperbolic graphs. I will talk about bi-infinite geodesics on FPP on a special class of non-hyperbolic graphs including some fractal graphs. I will state that there does not exist bi-infinite geodesic a.s. on a certain class of non-hyperbolic graphs containing the one-sided standard 2-dimensional Sierpinski gasket graph and on the other hand there exists bi-infinite geodesic a.s. on another class of non-hyperbolic graphs. Our assumptions for the weight distribution are minimal. If time is permitted, I will also talk about bi-infinite geodesics on FPP on on a class of infinite graphs including the one-sided standard 2-dimensional Sierpinski carpet graph and, as a by-product, show that such graph does not admit any (non-random) Morse quasi-geodesics.

Adrien Schertzer
Large deviations in quantum quasi-1D Coulomb systems
Universität Frankfurt, Germany

This is the second, and last paper in which we address the behavior of oriented first passage percolation on the hypercube in the limit of large dimensions. We prove here that the extremal process converges to a Cox process with exponential intensity. This entails, in particular, that the first passage time converges weakly to a random shift of the Gumbel distribution. The random shift, which has an explicit, universal distribution related to modified Bessel functions of the second kind, is the sole manifestation of correlations ensuing from the geometry of Euclidean space in in?nite dimensions. The proof combines the multiscale refinement of the second moment method with a conditional version of the Chen-Stein bounds, and a contraction principle.

Dominik Schmid
Exclusion processes on trees
TU München, Germany

The exclusion process is one of the best-studied examples of an interacting particle system. In this talk, we focus on the exclusion process on infinite trees. Our goal is to give limit theorems for the position of a tagged particle in the exclusion process. We give an overview over some recent results in the case of regular trees and Galton-Watson trees as well as a selection of open problems.

Dominic T. Schickentanz
Uniqueness of Invariant Distributions of Markov Processes
TU Darmstadt, Germany

We present a criterion for uniqueness of invariant distributions of topologically irreducible Markov processes which have the Feller property but not the strong Feller property. The criterion is a consequence of generalizing the Perron-Frobenius theorem to a functional analytic setting, namely to positive operators on what we call Banach lattice pairs.

Hauke Seidel
Convex Cones and Absorption Probabilities of Symmetric Gaussian Polytopes
Universität Münster, Germany

Let P be an n-dimensional regular cross-polytope, simplex or cube centred at the origin of $\mathbb{R}^n$. We consider convex cones of the form

$$C = \{\lambda x + \lambda e_{n+1} : \lambda \geq 0, x \in P\} \subset \mathbb{R}^{n+1},$$

where $e_1, \dots, e_{n+1}$ is the standard basis of $\mathbb{R}^{n+1}$. We shall derive explicit probabilistic expressions for the inner and outer solid angles of these cones. As a corollary, we shall derive a formula for the inner and outer solid angles of a regular cross-polytope. Furthermore, we shall explain how these cones are an important tool in determining the absorption probability of a symmetric Gaussian polytope $\mathscr{P}_{n,d}$, that is the probability that a deterministic point $x \in \mathbb{R}^d$ is contained in the convex hull of n independent standard normally distributed points $X_1, \dots, X_n$ in $\mathbb{R}^d$ together with their negatives $-X_1, \dots, -X_n$.

Boubaker Smii
A graph representation of a solution of a stochastic differential equation
King Fahd University of Petroleum and Minerals, Saudi Arabia

The aim of this work is to show how one can use random graphs to represent- in terms of series- the moments of the solution of a stochastic differential equation driven by a general noise. Truncated moments of the noise will be graphically represented as well. Computing the laws of the noise and therefore identifying its type (Gaussian, Poisson,...) will be possible and it will be also shown. Applications will be provided at the end of this work. Key words: SDE's, Lévy noise, Feynman graphs and rules, truncated moments.

András Tóbiás
Signal-to-interference ratio percolation for Cox point processes
Technische Universität Berlin, Germany

We study signal-to-interference plus noise (SINR) percolation for Cox point processes, i.e., Poisson point processes with random intensity measures, in two or higher dimensions. SINR percolation is an infinite-range dependent version of continuum percolation, where the connection between two points depends on all points of the point process. It was introduced by Dousse et al. for Poisson point processes in two dimensions. Hirsch, Jahnel and Cali recently studied continuum percolation for Cox processes. Based on the notion of stabilization, we find sufficient conditions under which the SINR graph has an infinite cluster if the density of the Cox point process is large enough and interferences are sufficiently reduced (without vanishing). A key example is when the intensity measure is given by a two-dimensional Poisson–Voronoi tessellation. We show that the total edge length of this random measure has some exponential moments, which implies percolation in the SINR graph in case the path-loss function decays polynomially with exponent at least 3. Further details about the subject of the talk can be found at arXiv:1808.09857.

Freimut von Loeper

Copula-based models for solar power supply to distribution networks, using global radiation forecasts

Universität Ulm, Germany

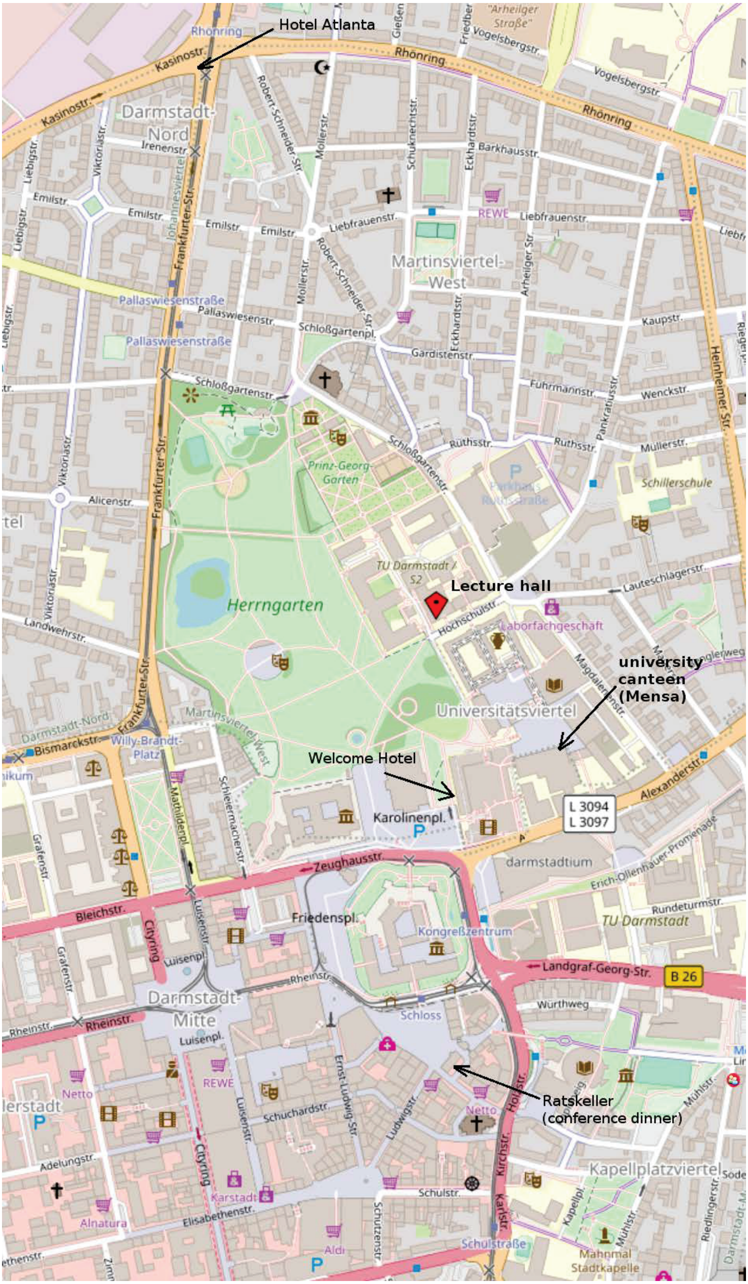
High reverse power flow of renewable energy in electricity distribution networks might lead to overloading problems and voltage violations causing huge economic damages as well as endangering secure network operation. In response to these problems new computer-based tools are developed, which aim to analyze the dependency between solar power supply and related weather phenomena, and, in this way, predict overloading problems and generate automatic warnings. In this talk, we present two different stochastic models for the prediction of solar power supply to distribution networks, based on temporal and spatially correlated weather forecasts for a 20x20 km grid covering the territory of Germany. In particular, by analyzing the dependency between solar power generated by solar fields and global radiation forecasts, we build probabilistic prediction models using the representation of multivariate probability distributions by copula functions. First, for purposes of data harmonization, we interpolate the radiation forecasts at the feed-in points of the considered solar fields by an inverse-distance weighting and normalize the supplied solar power for each of these locations to allow for comparison. Then, for each feed-in point we determine the joint probability distribution of global radiation forecast and supplied solar power at this location, by fitting both marginal distributions and a bivariate Archimedean copula. This allows us to estimate the conditional probability distribution of supplied solar power at each feed-in point, given an interpolated global radiation forecast at this location. Note that this conditional probability distribution is computed regardless of the global radiation forecasts at other locations. Furthermore, we determine the joint probability distribution of the n-dimensional vector of global radiation forecasts at n feed-in points, directly connected with a certain network control point, and the solar power supplied at this network node, i.e., the aggregated solar power generated at the n feed-in points. This $(n+1)$-dimensional probability distribution is fitted by means of D-vine copulas. Similar to the previously described two-dimensional case, we can then estimate the conditional probability distribution of supplied solar power at each network control point, given the vector of global radiation forecasts at the n feed-in points directly connected with this network node. Thus, we showed that global radiation forecasts can be used to generate probabilistic predictions of solar power supply at network control points.

Vladislav Vysotskiy
Large deviations for the perimeter of convex hulls of planar random walks
University of Sussex, United Kingdom

We study large deviations of the perimeter of the convex hull of a planar random walk making a large number of steps. For a wide class of distributions of increments of the walk, which includes Gaussian distributions, we find explicitly the rate function of the perimeter, and prove that its large deviations are attained on trajectories that asymptotically align into line segments. It is notable that for general distributions, the optimal asymptotic shape may not be a segment. If time allows, we also discuss large deviations of the area of the convex hull. This is a joint work with Arseniy Akopyan (IST Austria).

Steffen Winter
Geometric functionals of fractal percolation
Karlsruhe Institute of Technology, Germany

Fractal random sets such as fractal percolation or Boolean multiscale models exhibit a dramatic topological phase transition, changing from a dust-like set of isolated points into a connected cluster that spans the entire system. The precise transition points are typically unknown and difficult to estimate. In many classical percolation models percolation thresholds have been approximated well using additive geometric functionals, known as Minkowski functionals or intrinsic volumes. Motivated by the question whether a similar approach is possible for fractal models, we study corresponding geometric functionals for fractal percolation. These new functionals are closely related to (expected) fractal curvatures but they are easier to compute and can be estimated from simulations. They serve as geometric descriptors of the fractal percolation process and can be generalized to other random fractals. We discuss the existence of the functionals and obtain explicit formulas for both fractal percolation and its finite approximations. We also address their relation to percolation thresholds and to other geometric properties of the model. Based on joint work with Michael A. Klatt.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