São Paulo School of Advanced Science on Singular Stochastic Partial Differential Equations and Their Applications

and

XXV Brazilian School of Probability

Book of Abstracts

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List of Courses

• Introduction to Stochastic Calculus.

Paulo Ruffino (UNICAMP)

Abstract

This course serves as a basic introduction into the theory of stochastic integration. It is aimed at students with a basic knowledge in probability theory and analysis. The following topics will be covered :
• Brownian motion.
• Itô integration.
• Itô formula.
• Stochastic Differential equations

• Introduction to rough paths theory.

Sebastian Riedel (FernUniversität in Hagen)

Abstract

Rough paths theory was developed by Terry Lyons in the late 90s. It can be seen as the attempt to acquire a profound understanding of paths with possibly low (Hölder-) regularity. By now, the theory evolved and gained more and more importance in many different areas of mathematics, including stochastic analysis, numerics, PDE theory, and machine learning. In this course, we will concentrate on applications to stochastic (ordinary) differential equations. We will first present the standard objects in rough paths theory and discuss the analytic and algebraic background. Then we define controlled paths and the rough integral. This allows defining solutions to rough differential equations and to solve them under appropriate conditions. Next, we apply the theory to solve stochastic differential equations and compare it to the classical Itô-approach. Eventually, we will give an outlook on further applications and recent developments.

• Progress on Yang-Mills.

Martin Hairer (Department of Mathematics, Imperial College London)

Abstract

To be announced.

• Regularity Structures.

Lorenzo Zambotti (Sorbonne University)

Abstract

In this mini-course we want to present the general theory of regularity structures. We shall start from germs (family of distributions), and we shall discuss the Reconstruction Theorem and the multi-level Schauder estimates. Then we shall discuss the notions of models, modelled distributions, and the product of modelled distributions. In the last part of the mini-course we plan to give an introduction to the algebraic tools of the theory and the probabilistic result of convergence of renormalised models; to this aim we shall study a simple singular stochastic PDE and show how the general theory works in a toy model.

List of Plenary Talks

• Phase transitions for Φ^4_3.

Ajay Chandra (Imperial College London)

Abstract

The Φ^4_d Euclidean field theory is a classical model of mathematical physics and constitutes arguably one of the simplest examples of an interacting Quantum Field Theory. I will speak on some of the large-scale properties of the Φ^4 theory. It has been long understood that it has properties akin to the Ising model. In particular, it has a parameter which corresponds to "temperature" and the model exhibits a phase transition as this parameter is varied. This phase transition was first described in 2D in groundbreaking work by Glimm, Jaffe and Spencer 1975 [GJS75]. They derived contour bounds, somewhat in the spirit of Peierls classical work on the Ising model, and rigorously established long range order in the low temperature regime. In the more difficult 3D case the existence of a phase transition was established by Fröhlich, Simon and Spencer in 1978 using less quantitative positive methods.

I will discuss joint work with Trishen Gunaratnam and Hendrik Weber which provides a quantitative Peierls type argument akin to [GJS75] for the 3D case. We establish a large deviation bound on the average magnetisation which in turn quantifies the breakdown of ergodicity for the dynamics in the infinite volume limit. The key technical tool is a variational representation for expectations under the ϕ^4 measure, which was developed recently by Barashkov and Gubinelli.

• Contact process with renewal cures.

Luiz Renato Fontes (USP)

Abstract

We review recent results on the contact process on Z^d (and subsets thereof) with cures occurring according to iid renewal processes, one per site timeline. Infections occur as usual, among nearest neighbors, through a memoryless mechanism, with rate lambda.

We focus on the issue of whether the critical value of lambda for the occurrence of survival with positive probability of an infection started with a single infected site at the origin: $\lambda_c = 0$ is related to a heavy tail of the distribution of the renewal distribution; we will present our results to this effect — ie, a heavy tail implies $\lambda_c = 0$, and conversely. Heavy tail here roughly means inexistence of a first moment, but our results require varying size and regularity conditions on the tail of the renewal distributions, to be spelled out in the talk. We also plan to present results on the long time distribution of the process in the heavy tailed case.

Based on joint work with Pablo Gomes, Domingos Marchetti, Tom Mountford, Rémy Sanchis, Maria Eulália Vares and Daniel Ungaretti.

• Concurrent Donsker-Varadhan and hydrodynamical large deviations.

Claudio Landim (IMPA)

Abstract

We consider the weakly asymmetric exclusion process on the d-dimensional torus. We prove a large deviations principle for the time averaged empirical density and current in the joint limit in which both the time interval and the number of particles diverge. This result is obtained both by analyzing the variational convergence, as the number of particles diverges, of the Donsker-Varadhan functional for the empirical process and by considering the large time behavior of the hydrodynamical rate function. The large deviations asymptotic of the time averaged current is then deduced by contraction principle. The structure of the minimizers of this variational problem corresponds to the possible occurrence of dynamical phase transitions.

• Multi-scale stochastic systems with fractional Brownian motions.

Xue-Mei Li (Department of Mathematics, Imperial College London)

Abstract

Multi-scales are prevalent, so is correlated noise. The simplest Gaussian process with stationary correlated increments with power law decay is a fractional Brownian motion. Until very recently, very little were know of two scale stochastic equations with fractional noise. We shall explain recent progress in this frontier. In the Markovian case, there are 3 ways of obtaining effective motions :
1) averaging of the drift vector fields
2) average of the square of the diffusion vector fields
3) Diffusion creation.
We connect these three dots with a continuum of effect motions. We hope also to discuss fractional dynamics and Functional limit theorems for a class of non-markovian processes.

• Forward integration of bounded variation coefficients with respect to Hölder continuous process.

Soledad Torres (CIMFAV - Facultad de Ingeniería, Universidad de Valparaíso)

Abstract

In this work, we study the forward integral, in the Russo and Vallois sense, with respect to Hölder continuous stochastic processes Y with exponent bigger than $1/2$. Here, the integrands have the form $f(Y)$, where f is a bounded variation function. As a consequence of our results, we show that this integral agrees with the generalized Stieltjes integral given by Zähle and that, in the case that Y is fractional Brownian motion, this forward integral is equal to the divergence operator plus a trace term, which is related to the local time of Y

. Moreover, the definition of the forward integral allows us to obtain a representation of the solutions to forward stochastic differential with a possibly discontinuous coefficient and, as a consequence of our analysis, to figure out some explicit solutions.
Joint work with Johanna Garzón and Jorge León.

• Theory of probabilities, nonlinear dynamics and entropy within modern statistical mechanics.

Constantino Tsallis (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, Brazil; Santa Fe Institute, New Mexico, USA; Complex Systems Hub, Vienna, Austria)

Abstract

The statistical-mechanical approach to natural, artificial and social complex systems requires entropies that generalize the celebrated Boltzmann-Gibbs-von Neumann-Shannon expression. Consequently, the distributions of velocities and of energies of the relevant stationary states consistently generalize the Maxwellian and the Boltzmann-Gibbs distributions. From the mathematical standpoint, these generalizations are married with appropriate generalizations of the Central Limit Theorem and of the Large Deviation Theory. We shall briefly introduce this recent approach together with the consistent generalization of the Pesin identity for non-linear dynamical systems. To conclude, illustrative applications will be presented as well. An updated bibliography is available at http: //tsallis.cat.cbpf.br/biblio.htm

• On the contact process with dynamic edges or under renewals.

Maria Eulalia Vares (Universidade Federal do Rio de Janeiro)

Abstract

The talk will focus on a class of interacting systems which is built on a percolative structure similar to that used by T. Harris for the graphical construction of the contact process. This has been object of recent research by several authors (see [1] and references therein). After a brief discussion of a robust renormalization argument for the investigation of conditions that guarantee extinction, I will discuss how we apply these ideas to obtain results on the phase diagram of the Contact Process with Dynamic Edges introduced by Linker and Remenik in [2]. This is based on joint work with M. Hilário, D. Ungaretti, and D. Valesin.
[1] L. R. Fontes, T. S. Mountford, D. Ungaretti, M. E. Vares (2021). Renewal Contact Processes: phase transition and survival. arXiv: 2101.06207.
[2] A. Linker, D. Remenik (2020). The contact process with dynamic edges on $\mathbb{Z}$.*Electron. J. Probab.* **25**.
[3] M. Hilário, D. Ungaretti, D. Valesin, M. E. Vares (2021). Results on the contact process with dynamic edges or under renewals. arXiv: 2108.03219

List of Short Talks

• Regularisation by noise for SDEs with (fractional) Brownian noise and a comparison of different notions of solutions.

Lukas Anzeletti (Université Paris-Saclay, CentraleSupélec)

Abstract

We study existence and uniqueness of solutions to the equation $X_t = b(X_t)dt + dB_t$, where b may be distributional and B is a fractional Brownian motion with Hurst parameter $H \leq 1/2$. We follow two approaches, namely using the stochastic sewing lemma and nonlinear Young integrals in p-variation. Furthermore, in the Brownian case $H = 1/2$ we present examples of drifts in which the classical notion of a solution and solutions in a path-by-path sense coincide, respectively not coincide. Partly based on joint work with Alexandre Richard and Etienne Tanré.

• A Dynamical Model of the Turbulent Energy Cascade.

Gabriel B. Apolinário (Laboratoire de Physique, ENS de Lyon)

Abstract

Motivated by the modeling of three-dimensional fluid turbulence, we study a stochastic partial differential equation (SPDE) that is randomly stirred by a spatially smooth and uncorrelated in time forcing term. This dynamical evolution includes a linear but nonlocal interaction which is responsible for a cascading transfer of energy towards smaller scales. In the linear and Gaussian framework, the solution develops fractional regularity, for which we derive explicit predictions for the statistical behavior. Multifractal corrections are included drawing inspiration from a known probabilistic model, the Gaussian multiplicative chaos, which motivates the introduction of a quadratic interaction in this model. Through numerical simulations, we observe the non-Gaussian and in particular skewed nature of these solutions, an important feature in the modeling of turbulent velocity fields.

• An Itô-type formula for the KPZ equation.

Tom Klose (Technische Universität Berlin)

Abstract

The Kardar-Parisi-Zhang (KPZ) equation

$$\partial_t h = \partial_{xx} h + (\partial_x h)^2 + \xi$$

is a singular stochastic PDE that is used in statistical physics to model randomly growing interfaces.
In recent years, Hairer has developed an *intrinsic* solution theory for this equation which recovers the classical Cole-Hopf solution h.
One of the main features of this theory of *regularity structures* (RS) is the rigorous implementation of a renormalisation procedure that gives sense to the classically ill-defined term $(\partial_x h)^2$.
In this talk, I will describe how to obtain a stochastic PDE for $\phi(h)$ given a sufficiently regular function ϕ.
Our argument leverages the black-box theory of RS developed by Hairer and co-authors as well as integration by parts identities between certain renormalisation constants.
This is joint work in progress with Carlo Bellingeri (TU Berlin).

• The Sine-Gordon Transformation for a two-dimensional system of particles interacting in the continuum via a Yukawa pair potential..

Wilhelm Kroschinsky (University of São Paulo)

Abstract

Many problems in theoretical physics center on the study of functional integrals of the form:

$$Z[\psi] : = \int d\mu_C(\varphi) e^{-V(\varphi+\psi)}$$

where $\varphi = \{\varphi_x\}_{x\in X}$ is a Gaussian process with joint probability distribution μ_C, mean zero and covariance $C = (C_{xy})_{x,y\in X}$. In statistical mechanics, one is usually interested in studying the partition function of a system which is not necessarily given by a Gaussian integral, so one looks for ways of representing the partition function in terms of such integrals. This is usually done by performing the so-called Sine-Gordon transformation. If the cardinality of X is finite and the interaction between the constituent particles is sufficiently well-behaved, the transformation is easily implemented. However, when X is not finite, the problem becomes way more demanding and involves more sophisticated tools from probability and measure theory and functional analysis. In this talk, I will address the problem of performing a Sine-Gordon transformation for a two-dimensional system of particles interacting via a (regularized) Yukawa potential.

• Central limit theorem for non-equilibrium stationary states.

Rodrigo Marinho (Universidade Federal do Rio Grande do Sul)

Abstract

We consider a non-equilibrium, d-dimensional reaction-diffusion model with a unique stable density. We derive a quantitative version of the hydrostatic limit for its stationary state and we show that, up to dimension 3, the CLT of the density of particles with respect to the stationary state is given by a mean-zero Gaussian random variable with explicit variance. The proof uses a sharp upper bound on the relative entropy between its stationary measure, which is unknown, and the Bernoulli product measure associated with the stable density.

• A gradient version of the Generalized Symmetric Simple Exclusion Process.

Beatriz Salvador (Instituto Superior Técnico(Universidade de Lisboa))

Abstract

In this talk, we will introduce the Generalized Symmetric Simple Exclusion Process with open boundary with a choice of rates for which this interacting particle system is gradient. We will also see recent results on bounds for the decay of the time dependent two-points correlation function of this model. The obtained estimates strongly depend on the fact that, by means of duality, we can relate this process with the Generalized Symmetric Simple Exclusion Process with only absorbing boundary. These bounds represent one of the building blocks to analyse the fluctuations of the process.

• A diagram-free approach to the stochastic estimates in regularity structures.

Markus Tempelmayr (Max-Planck-Institute for Mathematics in the Sciences)

Abstract

We consider the renormalized model for quasi-linear parabolic SPDEs. Instead of a tree-based approach, the model is indexed by partial derivatives w.r.t. the Taylor coefficients of the non-linearity, allowing to organize elements of the same noise homogeneity in linear combinations. We construct and stochastically estimate the renormalized model in the full subcritical regime, avoiding the use of Feynman diagrams but still in a fully automated, i.e. inductive way.

We assume a spectral gap inequality on the (not necessarily Gaussian) noise ensemble. The resulting control on the variance of the model naturally complements its vanishing expectation arising from the BPHZ-choice of renormalization. Our approach is analytic and top-down rather than combinatorial and bottom-up.

This is joint work with Pablo Linares, Felix Otto and Pavlos Tsatsoulis.

• Scaling limit of local functions in one-dimensional exclusion processes out of equilibrium.

Tiecheng Xu (UFBA)

Abstract

In this talk we will discuss how to derive the non-equilibrium fluctuations of some local functions of one-dimensional exclusion processes in the finite volume. To explain ideas of the proof, we deal with a specific but quite general model, the spatially inhomogeneous, weakly asymmetric simple exclusion processes on the one-dimensional discrete torus $\mathbb{T}_n$. Our proof relies on the refined Yau's relative entropy method, recently introduced by Jara and Menezes. Based on joint work with Luiz Renato Fontes(IME-USP).

Posters Session

Tuesday, August 9

• A Stochastic Lagrangian formulation of the incompressible Euler and related transport equations.

Juan David Londoño Acevedo (UNICAMP)

Abstract

In this poster i show up a d-dimensional stochastic Euler equations with a noise are considered. A Constantin-Iyer type representation in Euler-Lagrangian form is given, based in stochastic characteristics. I want to proof if local existence and uniqueness of solution in suitable sobolev spaces is proved from the Euler-Lagrangian formulation

• The inaccuracy measure between point processes related to Markov chains.

Vanderlei da Costa Bueno (Institute of Mathematics and Statistics, São Paulo University)

Abstract

An alternate measure of entropy based on distribution function rather than the density function of a random variable, called cumulative residual entropy (CRE), was proposed in Rao et al. which has been extended to cumulative residual inaccuracy measure by Taneja and Kumar . Observing two absolutely continuous positive random variables and using a point process martingale approach Bueno and Balakrishnan (2022) extended the definition to a symmetric inaccuracy measure. In this framework we define an inaccuracy measure between two point processes and apply it to Markov chains occurrence times. The result is:
Let $\mathbf{T} = (T_n)_{n\geq 0}$, and $\mathbf{S} = (S_n)_{n\geq 0}$ be point processes with $\Im_t^V$-compensator processes $(A_t)_{t\geq 0}$ and $(B_t)_{t\geq 0}$, respectively, defined in a complete probability space $(\Omega, \Im, P)$. Let $(V_n)_{n\geq 0}$ be their superposition process. Then, the cumulative residual inaccuracy measure, at time t, between $\mathbf{T}$ and $\mathbf{S}$ is given by

$$CRI_t(N^{\mathbf{T}}, N^{\mathbf{S}}) = E[\int_0^t A_s ds + \int_0^t B_s ds] = E[\Sigma_{n=1}^{N_t^{\mathbf{V}}}|V_n - V_{n-1}|].$$

Interpretation: provided that we identify random variables that are equal almost everywhere, the quantity $\Sigma_{k=1}^{\infty}|V_k - V_{k-1}|$, as t goes to infinity, $CRI_t(N^{\mathbf{T}}, N^{\mathbf{S}})$ can be interpreted as a metric in the L^1 space of random variables sequences and can be seen as a dispersion measure

when using the point process $\mathbf{S}$, asserted by the experimenter information of the true point process $\mathbf{T}$.

References

[1] Bueno, V.C. and Balakrishnan, N.(2022). A cumulative residual inaccuracy measure for coherent systems at component level and under nonhomogeneous Poisson processes. Probability in the Engineering and informational Sciences,36, $294-319$.

• Critical parameter of the frog model on homogeneous trees with geometric lifetime.

Caio Augusto de Carvalho Pena (UFSCar-USP)

Abstract

We consider the frog model with geometric lifetime (parameter $1-p$) on homogeneous trees of dimension d. In 2002, Alves, O. S. M. and Machado, F. P. and Popov, S. Yu proved that there exists a critical lifetime parameter $p_c \in (0,1)$ above which infinitely many frogs are activated with positive probability, and they gave lower and upper bounds for p_c. Since then, the literature on this model focussed on refinements of the upper bound. We improve the lower bounds for p_c. To improve the lower bound for the critical parameter, we compared the frog model with a multi-type branching process.

• Limiting shape for First-Passage Percolation models on Random Geometric Graphs.

Lucas R. de Lima (UFABC - Federal University of ABC, Brazil)

Abstract

Let a random geometric graph be defined in the supercritical regime for the existence of a unique infinite connected component in Euclidean space. Consider the first-passage percolation model with independent and identically distributed random variables on the random infinite connected component. We provide sufficient conditions for the existence of the asymptotic shape and we show that the shape is an Euclidean ball. We give some examples exhibiting the result for Bernoulli percolation and the Richardson model. For the Richardson model we further show that it converges weakly to a nonstandard branching process in the joint limit of large intensities and slow passage times.
This is a joint work with Cristian F. Coletti, Alexander Hinsen, Benedikt Jahnel, Daniel Valesin

• On the convergence of the Drainage Network Model with Branching.

Rafael Souza dos Santos (Universidade Federal do Rio de Janeiro (UFRJ))

Abstract

We introduce the Drainage Network with Branching, which is a system of coalescing random walks with paths that can branch and that exhibit some dependence before coalescence. It extends the Drainage Network model introduced by Gangopadhyay, Roy and Sarkar in 2004, by allowing the paths to branch. We also study the convergence of the Drainage Network with Branching, under diffusive scaling, to the Brownian Web or Net, according to specific conditions for the branching probability. We show that based on the specification of the branching probability, we can have convergence to the Brownian Web or we can have a tight family such that any weak limit point contains a Brownian Net. In the latter case, we conjecture that the limit is indeed the Brownian Net. This is a joint work with Glauco Valle (IM-UFRJ) and Leonel Zuaznabar (IME-USP).

• Recent theoretical results about Hilbert space embeddings of probabilities..

Jean Carlo Guella (Unicamp-IMECC)

Abstract

We review some recent theoretical results about Hilbert space embeddings of probabilities, like the fact that Gaussian kernels on Hilbert spaces define an inner product in the space of measures with bounded variation and that the standard metric in Hilbert and real/complex hyperbolic spaces are of the strong negative type. We also present the concept of positive definite independent kernels, which generalizes the concepts of Hilbert Schmidt Independence Criterion and Distance Covariance, provides a metric in the space of couplings, and are related to Bernstein functions with 2 variables.

• Non-geometric rough paths on manifolds.

Alvaro Enrique Machado Hernandez (UNICAMP)

Abstract

In this poster we will present some results about non-geometric rough paths on Riemannian manifolds

• Skeptical Firework Process: a modified model of information propagation in $\mathbb{N}$..

Lissa Kido Higashizawa (Federal University of São Carlos (UFSCar))

Abstract

The “Firework Process” (FP) is a model of information propagation on the naturals ($\mathbb{N}$) that propagates unidirectionally from zero to infinity. Each individual has a radius, independently and identically distributed (iid), which determines how many individuals he can reach with the information. Previous works gave an explicit formula for the probability of survival of the

information, as function of the radii distribution. Here we consider a modification of the FP that we call "Skeptical Firework Process" (SFP). In this model, individuals will only believe the information and become propagators if they are informed by at least two propagators. We study survival using the reverse process, which falls in the class of semi-Markov processes.

• Explicit Bivariate Rate Functions for Large Deviations in AR(1) Processes with Gaussian Innovations.

Maicon Josué Karling (King Abdullah University of Science and Technology)

Abstract

For this poster session, we are going to present the large deviation properties for the sequence of random vectors

$$(\mathcal{W}_n)_{n\geq 2} = \left(n^{-1}(\sum_{k=1}^{n} X_k^2, \sum_{k=2}^{n} X_k X_{k-1})\right)_{n\geq 2}$$

when $X_1, \ldots, X_n$ is a sample from the centered stationary AR(1) processes with independent Gaussian innovations. In the reasoning used to obtain our main result, we prove a version of the Large Deviation Principle (LDP) [see section 1.2 in Dembo, A. and Zeitouni, O. (2010) *Large Deviations Techniques and Applications*, New York: Springer-Verlag, 2nd edition] which is weaker than the classical one found in the literature. We prove such principle by verifing the validity of the Gärtner-Ellis' theorem's conditions, as little use of the dependency structure is made and the focus mainly rests in the behavior of the limiting cumulant generating function. A detailed analysis of when a given family of Toeplitz matrices is positive definite is necessary. We also consider the concepts of steep function, exposed points and exposed hyperplane to give its proof. In fact, we show that there are sets such that the upper bound is different from the lower bound in the LDP estimate. As some particular cases, via the Contraction Principle, we provide explicit rate functions for the sample mean, sample second moment and first order empirical autocovariance of this process. Likewise, we present a new proof for an already known result on the explicit deviation function for the Yule-Walker estimator. The results mentioned above are based on a collaborative work from Dr. Maicon J. Karling, Dr. Artur O. Lopes (UFRGS, Brazil), and Dr. Sílvia R. C. Lopes (UFRGS, Brazil), and it is a part of the first author's Ph.D. thesis, defended on October 14^{th}, 2021.

• On stochastic transport equation driven by space-time white noise.

Josué Knorst (Federal University of Rio Grande do Sul)

Abstract

We develop a solution theory for stochastic transport equation driven by space-time white noise. Such equation, as idealized limit of microscopic models, usually arises in ways more than one. However, in order to be concrete, we focus on one particular relatively simple

microscopic approximation $\partial_t u_\epsilon = D_x u_\epsilon \circ \xi_\epsilon$. The solution is in essence a stochastic version of DiPerna-Lions renormalized solution. We carefully identify a set of coordinates which do not "feel" about singularities produced by the white noise. Work in progress with Jin Feng.

• Besov Reconstruction.

David Lee (Sorbonne: LPSM)

Abstract

The reconstruction theorem tackles the problem of building a global distribution, on $\mathbb{R}^d$ or on a manifold, for a given family of sufficiently coherent local approximations. This theorem is a critical tool within Hairer's theory of Regularity Structures. In this paper, we establish a reconstruction theorem in the Besov setting, extending recent results of Caravenna and Zambotti. A Besov reconstruction theorem was first formulated by Hairer and Labbé in the context of regularity structures, exploiting nontrivial results from wavelet analysis. Our calculations follow the more elementary approach of coherent germs due to Caravenna and Zambotti. With this formulation our results are both stated and proved with tools from the theory of distributions without the need of the theory of Regularity Structures. As an application, we present an alternative proof of a (Besov) Young multiplication theorem which does not require the use of para-differential calculus.

Thursday, August 11

• Community detection for the stochastic block model by maximum likelihood, revisited..

Florencia Leonardi (Universidade de São Paulo)

Abstract

We consider the general stochastic blockmodel with k communities and the problem of detecting the subjacent partition of vertices with maximum likelihood. This approach has been previously considered by Chen and Bickel (2009), but their proof of the consistency of the maximum likelihood estimator was based on a Lipchitz hypothesis that is not globally true, so the proof remain incomplete, as pointed out in van der Pas and van der Vaart (2018). In this work we show that under some additional hypotheses on the estimator, the local Lypchitz property is sufficient for consistency. It remains open if the additional hypotheses could be relaxed or not. Moreover, by using different concentration inequalities, we show that the maximum likelihood estimator is consistent above the phase transition threshold, for networks with logarithmic degree regime. This is a joint work with Andressa Cerqueira (UFSCAR).

• Some geometrical aspects of Young integral: decomposition of flows .

Lourival Lima (State University of Campinas)

Abstract

In many kinds of dynamical systems, in order to obtain local or asymptotic parameters of the dynamics, one performs a befitting decomposition of the associated flow, depending on the geometrical or analytical context. For example, given a flow in a Riemannian manifolds, one can write this flow (up to some geometrical conditions) as a Markovian process in the group of isometries of the manifold composed with a process in the Lie group of diffeomorphisms which fix a point in the manifold. Another interesting decomposition is related to a pair of complementary foliations in a manifold: a stochastic flow can be written as a Markovian process in the Lie group of diffeomorphisms which act on the leaves of one foliation with a process in the Lie group of diffeomorphisms which act on the leaves of the other foliation. Throughout this talk, we are going to make this second example more precise in the context of low regularity: namely we explore the geometry of the Young integral in a manifold. Particularly, our decomposition is based on an Itô-Kunita-Ventzel formula for alpha-Hölder paths.

• From stochastic hamiltonian systems to stochastic compressible Euler equation.

Jesus Manuel Correa Lora (Instituto de Matemática, Estatística e Computação Científica)

Abstract

For all $N \in \mathbb{N}$ we consider N the particles $\{X_N^i\}$ in $\mathbb{R}^d$ where the position X_N^k verifies

$$d^2 X_N^k(t) = -\frac{1}{N}\sum_{l=1}^{N} \nabla\phi_N\left(X_N^k(t) - X_N^l(t)\right)dt + \varphi(X_N^k)\circ dB_t \quad k = 1, \cdots, N$$

where $\{B_t^i)_{t\in[0,T]},\ i \in \mathbb{N}\}$ is a family of standard $\mathbb{R}^d$-valued Brownian motions defined on a filtered probability space. Our aim is the study of the asymptotics as $N \to \infty$ of the time evolution of the whole system of all particles. Therefore, we investigate the empirical processes :

$$S_t^N :\ = \frac{1}{N}\sum_{k=1}^{N} \delta_{X_N^k(t)},$$

$$V_t^N :\ = \frac{1}{N}\sum_{k=1}^{N} V_N^k(t)\delta_{X_N^k(t)}$$

where $dX_N^k(t) :\ = V_N^k(t)dt$ is the velocity of the kth particle, and δ_a, denotes the Dirae measure at a. We shall prove that S_t^N and V_t^N converge as $N \to \infty$ to solutions of the continuity equation and the stochastic Euler equation, respectively.

• Longest weakly increasing subsequences of discrete random walks with heavy and ultra-heavy tailed distribution of increments.

José Ricardo G. Mendonça (Escola de Artes, Ciências e Humanidades - USP)

Abstract

Up until recently, the longest increasing subsequences (LIS) of random walks and other types of time series have remained a relatively unexplored subject despite their potential applications in fields like data stream analytics and reliability. In this poster we report preliminary results on the behavior of the length of the longest weakly increasing subsequences (weak LIS) of n-step random walks with symmetric heavy tailed distribution of increments proportional to $|k|^{-1-\alpha}$ for a couple of different real parameters $\alpha > 0$ together with that of the so-called symmetric ultra-fat tailed random walk, which corresponds to the limit of a very heavy tailed α-stable distribution with $\alpha = 0$. We found, numerically, that the sample average length $\langle L_n \rangle$ of the weak LIS of such random walks scales with the length n of the walk like $\langle L_n \rangle \sim \sqrt{n} \log n$ when the distribution of increments has finite variance ($\alpha > 2$) and $\langle L_n \rangle \sim n^{\theta}$ with a varying exponent $\theta > 0.5$ when the distribution of increments has infinite variance ($\alpha \leq 2$). We also found numerical evidence for the universality of the distribution of the random variable L_n, in agreement with previous results for the LIS of other types of heavy tailed random walks.

• An exclusion process interpolating slow and fast diffusion.

Gabriel Silva Nahum (Instituto Superior Técnico, Universidade de Lisboa)

Abstract

In this talk we present a nearest neighbour interacting particle system of exclusion type, which illustrates a transition from constant to slow or fast diffusion. More precisely, the hydrodynamic limit of this microscopic system in the diffusive space-time scaling is the parabolic diffusion equation with diffusion coefficient $D(\rho) = m\rho^{m-1}$ and $m \in (0, 2]$, including therefore the fast diffusion regime (*i.e.* $m \in (0, 1)$), and the porous medium equation for non-integer $m \in (1, 2)$. The model construction is based on the generalized binomial theorem, and interpolates continuously in m the already known microscopic porous medium model with parameter $m = 2$ and the symmetric simple exclusion process ($m = 1$), while going further into a fast diffusion model up to $m > 0$. The formalization of the hydrodynamic limit for the local density of particles on the one dimensional torus is achieved via the entropy method – with additional technical difficulties depending on whether we are considering the fast or slow diffusion regime.

• Stochastic Landau-Lifshitz-Gilbert equation.

Evelina Shamarova (Universidade Federal da Paraíba)

Abstract

We consider the following stochastic Landau-Lifshitz-Gilbert (LLG) equation perturbed by a space-time white noise:

$$\mathbf{u}_t = (\beta \mathbf{u} \times \mathbf{u}_{xx} - \alpha \mathbf{u} \times (\mathbf{u} \times \mathbf{u}_{xx}))dt + \mathbf{u} \times \circ \dot{\zeta},$$

where $\mathbf{u}$ takes values in $\mathbb{R}^3$ and $\dot{\zeta}_t$ is a 3D space-time white noise. The above equation is used for modeling of effects of a magnetic field in ferromagnetic materials. Our approach to solving this problem is as follows. The stochastic LLG equation is reduced to an equivalent system of equations by using of the stochastic Hasimoto-type transform, first introduced by M. Neklyudov in an unpublished manuscript [1]: $(q^1, q^2, q^3) = |\mathbf{u}_x| e^{i \int_{-\infty}^{\cdot} \frac{<\mathbf{u}\times\mathbf{u}_x, \mathbf{u}_{xx}>}{|\mathbf{u}_x|^2} dy}$. This leads to the following system of equations with respect to (q^1, q^2, q^3):

$$\partial_t q^1 = \alpha\big[\partial_{xx} q^1 - 2q^3 \partial_x q^2 - q^1 |q^3|^2\big] - \gamma q^3 \circ \dot{\xi}^2 + \gamma \partial_x \dot{\xi}^1,$$

$$\partial_t q^2 = \alpha\big[\partial_{xx} q^2 + 2q^3 \partial_x q^1 - q^2 |q^3|^2\big] + \gamma q^3 \circ \dot{\xi}^1 + \gamma \partial_x \dot{\xi}^2,$$

$$\partial_t q^3 = \alpha\big[\partial_{xx} q^3 - q^2 \partial_x q^1 + q^1 \partial_x q^2 + q^3(|q^1|^2 + |q^2|^2)\big] + \gamma(q^1 \circ \dot{\xi}^2 - q^2 \circ \dot{\xi}^1),$$

where $\dot{\xi}^1$ and $\dot{\xi}^2$ are independent space-time white noises.
The above parabolic system is studied by means of the theory of paracontrolled distributions. It is equivalent to the original equation in the case when the energy of the system, i.e., the energy of interaction between particles, has just one component. In spite of being the simplest case, it is non-trivial and interesting in physics. This talk is based on a joint work with M. Neklyudov (UFAM).

References

[1] M. Neklyudov, Hashimoto transform for stochastic Landau-Lifshitz-Gilbert equation, arXiv: 1401.2520, 2014.

• The effect of a small bounded noise on the structure of autonomous attractors.

Alexandre do Nascimento Oliveira Sousa (UNICAMP)

Abstract

We study the continuity and topological structural stability of attractors for nonautonomous random differential equations obtained by small bounded random perturbations of autonomous semilinear problems. First, we study the existence and permanence of unstable sets of hyperbolic solutions. Then, we use this to establish the lower semicontinuity of nonautonomous random attractors and to show that the gradient structure persists under nonautonomous random perturbations.

• A lower bound for the blowup probability of positive solutions of a semilinear SPDE driven by a fractional noise.

Gerardo Pérez Suárez (Centro de Investigación en Matemáticas (CIMAT))

Abstract

In this poster, we consider the following semilinear SPDE:

$$\mathrm{d}u(t,x) = \left(\Delta u(t,x) + \gamma u(t,x) + (u(t,x))^{1+\beta}\right)\,\mathrm{d}t + \sum_{k=1}^{n} \sigma_k u(t,x)\,\mathrm{d}B_t^{H_k}$$

on a bounded smooth domain $D \subset \mathbb{R}^d$, with Dirichlet boundary condition, where $\gamma, \sigma_k \in \mathbb{R}$, $\beta > 0$, and $B^{H_1}, \ldots, B^{H_n}$ are independent fractional Brownian motions with Hurst indexes $1/2 \leq H_1 \leq \cdots \leq H_n \leq 1$. We present results on existence, uniqueness and blowup behaviour of positive weak solutions which are derived by means of the associated random partial differential equation, obtained by the transformation $v(t,x) = e^{-X_t}u(t,x)$, where $X_t = \sum_{k=1}^{n} \sigma_k B_t^{H_k}$.
In special, we establish a lower bound for the probability of explosion in finite time of positive solutions. This poster is based on joint work in progress with J.A. López-Mimbela.

• Slow phase for ARW with large particle density.

Célio A. Terra (Universidade Federal de Minas Gerais)

Abstract

Activated Random Walks (ARWs) are a classic example of processes that show critical behavior and phase transitions. Relatively little is known about the dynamics of the system in the regime of high sleeping rate.
Hoffman, Richey and Rolla proved the existence of an active phase for the symmetric ARW on $\mathbb{Z}$ for every sleeping rate λ. However, it was necessary to assume a specific initial configuration of particles. This assumption does not invalidate the proof, but an argument that precludes this assumption can be more transparently adapted to show a slow phase on the cycle $\mathbb{Z}/n\mathbb{Z}$.
In this work, we extend the procedure in the original paper of Hoffman, Richey and Rolla by taking an arbitrary initial configuration, and present some conjectures and initial steps of the proof this new procedure works.
Joint work with Bernardo N.B. de Lima and Leonardo T. Rolla.

• Euclidean and chemical distances in ellipses percolation.

Daniel Ungaretti (UFRJ)

Abstract

The ellipses model is a continuum percolation process in which ellipses with random orientation and eccentricity are placed in the plane according to a Poisson point process. A parameter α controls the tail distribution of the major axis' distribution and we focus on the regime $\alpha \in (1, 2)$ for which there exists a unique infinite cluster of ellipses and this cluster fulfills the so-called highway property. We prove that the distance within this infinite cluster behaves asymptotically like the (unrestricted) Euclidean distance in the plane. We also show that the chemical distance between points x and y behaves roughly as $c \log\log|x - y|$. The paths we build for obtaining small Euclidean and chemical distances use different strategies and give an overview of how long ellipses play a role in connecting far away points. The observed behavior can be compared with models such as Poisson cylinders model and long-range percolation. Joint work with Marcelo Hilário (UFMG).

• Large Deviations for Small Noise Diffusions Over Long Time.

Pavlos Zoubouloglou (University of North Carolina Chapel Hill)

Abstract

In this work we study the large deviations behavior of certain stochastic dynamical systems with small noize over long time horizon. First, we establish a large deviations principle for the empirical measure associated with a diffusion with decaying noize. Then, We consider a two-scale system of Ito stochastic differential equations, where both have a decaying noize in their natural time scales. A large deviations principle is obtained for the "slow" component and the empirical measure associated with the "fast" component. Here, the drift terms are fully coupled, in the sense that they may depend on the state of both components. The technique of this proof is based on a stochastic control representation for expectations of exponentials of finite dimensional Brownian motions coupled with weak convergence tools.