Conférence annuelle du GDR branchement

Rapport sur les contributions

https://indico.math.cnrs.fr/e/12161

ID de Contribution: **3** Type: **Non spécifié**

Mini cours : F-KPP equations, Feynman-Kac formulas, and branching Brownian motion

lundi 27 janvier 2025 09:00 (1h 20m)

In this minicourse, I will explain how Feynman-Kac formulas can be used to solve Fisher-Kolmogorov-Petrovsky-Pikunov equations (F-KPP). Maury Bramson first used this approach in his seminal paper on the F-KPP equation about 50 years ago. We will revisit his approach and then also apply this technique to systems of F-KPP equations. Moreover, I will explain the duality between (certain) F-KPP equations and spatial branching processes (such as branching Brownian motion).

Orateur: HARTUNG, Lisa

ID de Contribution: **4** Type: **Non spécifié**

Mini cours : Hawkes processes to model biological neuronal network

lundi 27 janvier 2025 10:40 (1h 20m)

I will give an introductory course on point processes that are used to model nueornal activity in the brain. I will especially focus on Hawkes processes even if I will recall some basic notions on Poisson processes as well. I will review the various methods to simulate such networks when the size is huge and comparable to animal brains or brain areas. A new algorithm especially involves Kalikow decomposition and can be seen as a branching process. Based on this view, we can also go a step further and try to understand how such neuronal network may learn to classify thanks to caracteristics detection.

Orateur: REYNAUD-BOURET, Patricia

ID de Contribution: **5** Type: **Non spécifié**

Mini cours: Scaling limits of branching random walks

lundi 27 janvier 2025 14:00 (1h 20m)

We consider a branching random walk whose genealogy is given by the family tree of a Bienaymé branching process conditioned to have n vertices. Think of this model as a random tree in which each vertex has a spatial location that is given by the position of its parent plus its own random displacement.

In the first lecture, we will consider the convergence under rescaling of the underlying tree to the Brownian continuum random tree, using a stick-breaking construction of the tree.

In the second lecture, we will enrich the stick-breaking construction to also encode the branching random walk, and show convergence under rescaling to the Brownian snake.

In the third and final lecture, we will discuss an application to the difference of the height process and Lukasiewicz path of Bienaymé trees, and an application to the height process of random looptrees.

These lectures are partially based on a forthcoming work with Louigi-Addario Berry, Christina Goldschmidt and Rivka Mitchell.

Orateur: DONDERWINKEL, Serte

ID de Contribution: **6** Type: **Non spécifié**

Mini cours : F-KPP equations, Feynman-Kac formulas, and branching Brownian motion

lundi 27 janvier 2025 15:40 (1h 20m)

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Orateur: HARTUNG, Lisa

ID de Contribution: **7** Type: **Non spécifié**

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Orateur: REYNAUD-BOURET, Patricia (Université Côte d'Azur, CNRS, LJAD)

ID de Contribution: **8** Type: **Non spécifié**

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Orateur: DONDERWINKEL, Serte

ID de Contribution: **9** Type: **Non spécifié**

Mini cours : F-KPP equations, Feynman-Kac formulas, and branching Brownian motion

mardi 28 janvier 2025 13:30 (1h 10m)

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Orateur: HARTUNG, Lisa

ID de Contribution: **10** Type: **Non spécifié**

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Orateur: REYNAUD-BOURET, Patricia (Université Côte d'Azur, CNRS, LJAD)

ID de Contribution: **11** Type: **Non spécifié**

Coffee break

ID de Contribution: **12** Type: **Non spécifié**

Non-linear conductances of Galton-Watson trees

mercredi 29 janvier 2025 09:00 (45 minutes)

Some statistical mechanics models on trees may sometimes reduce to the study of some "simple" tree recursion; this is for instance the case for the Ising model and FK-percolation model. It turns out that when the recursion is concave, we can compare this tree recursion to the one verified by (possibly non-linear) resistive networks.

I will present some recent work with Irene Ayuso Ventura (Durham), in which we obtain precise estimates on the asymptotic behaviour of non-linear conductances of Galton-Watson trees, also deriving some information on the FK-percolation model on random trees.

Orateur: BERGER, Quentin (Sorbonne Université)

ID de Contribution: **13** Type: **Non spécifié**

Ising model on a Galton-Watson tree with a random external field.

mercredi 29 janvier 2025 09:45 (45 minutes)

We study the Ising model on a Galton-Watson tree with a random external field, which can be interpreted as randomly introducing "interfering vertices" with a fixed spin. This model is motivated by the study of the Ising model on tree-like random graphs, which can serve as a framework for understanding cooperative behaviour in social networks. In joint work with Quentin Berger (Sorbonne Nord), we establish necessary and sufficient conditions for a phase transition in this setting. Our proof relies on both a beautiful tree-pruning technique and non-linear conductances on trees.

Orateur: AYUSO VENTURA, Irene (Durham University)

ID de Contribution: **14** Type: **Non spécifié**

Uncountably many extremal inhomogeneous states for the Ising model on regular tilings of the hyperbolic plane

mercredi 29 janvier 2025 10:45 (45 minutes)

Series-Sinai have shown in the nineties that the ferromagnetic n.n. Ising model defined on the Cayley graph of a co-compact group of isometries of the hyperbolic plane $\mathbb{H}_2$ exhibits uncountably many, mutually singular Gibbs states at very low temperature —one for every bi-infinite geodesic of $\mathbb{H}_2$.

They also conjectured the extremality of their states but the problem has been open ever since.

In this talk I will prove the existence of uncountably many extremal inhomogeneous Gibbs states for the Ising model on regular tilings of $\mathbb{H}_2$. I will also prove a refined Peierls bound for the critical temperature and sketch a few research directions.

Joint work with Loren Coquille (Institut Fourier, Grenoble) and Arnaud Le Ny (LAMA, Université Paris-Est Créteil).

Orateur: D'ACHILLE, Matteo (Laboratoire de Mathématiques d'Orsay, Université Paris-Saclay)

ID de Contribution: **15** Type: **Non spécifié**

Discounted tree sums in branching random walks.

mercredi 29 janvier 2025 11:30 (45 minutes)

This talk is based on a joint work with Eile Aïdékon and Zhan Shi. Let $(V(u),\, u \in T)$ be a (supercritical) branching random walk and $(\eta_u,\, u \in T)$ be positive marks on the vertices of the tree, distributed in an i.i.d. fashion. Following Aldous and Bandyopadhyay (2005), for each infinite ray ξ of the tree, we associate the {\it discounted tree sum} $D(\xi)$ which is the sum of the $e^{-V(u)}\eta_u$ taken along the ray. We take interest in the finiteness of $\sup_\xi D(\xi)$. To this end, we study the extreme behaviour of the local time processes of the paths $(V(u),\, u \in \xi)$. It answers a question of Nicolas Curien, and partially solves Open Problem 31 of Aldous and Bandyopadhyay.

Orateur: M. HU, Yueyun

ID de Contribution: **16** Type: **Non spécifié**

The planted matching problem

mercredi 29 janvier 2025 14:00 (45 minutes)

This talk will present some results on the planted matching problem, an inference problem where the goal is to recover a perfect matching hidden (planted) in a weighted graph, the weights on the planted and non-planted edges being drawn from two different distributions. The results are obtained with statistical mechanics techniques, and in particular a mapping to branching random walks.

Joint work with Gabriele Sicuro and Lenka Zdeborova, Phys. Rev. E 102, 022304 (2020).

Orateur: M. SEMERJIAN, Guilhem

ID de Contribution: **17** Type: **Non spécifié**

Products of positive random matrices and branching processes in random environments: limit theorems and large deviations

mercredi 29 janvier 2025 14:45 (45 minutes)

In this talk, I will present some recent progress in the study of products of positive random matrices and branching processes in random environments. In particular, a Perron-Frobenius type theorem and stable convergence theorem for products of positive random matrices, and a Bahadur-Rao type precise large deviation result for multitype branching processes in random environments, will be presented. (Mainly based on joint works with Ion GRAMA and Thi Trang NGUYEN)

Orateur: M. QUANSHENG, Liu

ID de Contribution: **18** Type: **Non spécifié**

SLE(6) on Liouville quantum gravity as a growth-fragmentation process.

mercredi 29 janvier 2025 15:45 (45 minutes)

We study the branching structure induced by a space-filling SLE(6) exploration of the quantum disc with matching parameter. We prove that it can be described as one of the growth-fragmentation processes introduced by Bertoin, Budd, Curien and Kortchemski in the context of planar maps. Importantly, our arguments are elementary, relying only on planar Brownian motion, and requiring no prior knowledge on LQG, once translated through the mating of trees. To this end, we develop new elements of excursion theory for cone excursions of Brownian motion and explore their connections to stable Lévy processes. This set of tools provides new elementary proofs of some of the key properties of the above SLE/LQG coupling. This talk is based on joint work with Ellen Powell (Durham) and Alex Watson (UCL).

Orateur: M. DA SILVA, William

ID de Contribution: **19** Type: **Non spécifié**

Local times of Brownian motion indexed by the Brownian tree

mercredi 29 janvier 2025 16:30 (45 minutes)

Brownian motion indexed by the Brownian tree appears in the asymptotics of many models of combinatorics or statistical physics, and is also closely related to super-Brownian motion. We consider the process of local times of (one-dimensional) Brownian motion indexed by the Brownian tree and we show that, although this process is not Markov, the pair formed by the local time and its derivative is a Markov process. In a work in collaboration with Ed Perkins, we prove that this pair satisfies a stochastic differential equation whose drift involves the classical Airy function. This is an analog of the well-known Ray-Knight theorems for linear Brownian motion.

Orateur: M. LE GALL, Jean-François

ID de Contribution: **20** Type: **Non spécifié**

A branching particle system as a model of FKPP fronts

jeudi 30 janvier 2025 14:45 (45 minutes)

The FKPP equation is a common model in population dynamics, describing how a population spreads and grows over time and space, resulting in wave-like patterns.
Recent studies by Birzu, Hallatschek and Korolev on the noisy FKPP equation with Allee effects (or cooperation) suggest the existence of three classes of fluctuating wavefronts: pulled, semipushed and fully pushed fronts.
In this talk, I will introduce an analytically tractable model for fluctuating fronts, describing the internal mechanisms that drive the invasion of a habitat by a cooperating population. I will then use this model to explain how such mechanisms shape the genealogy of the population.

Orateur: TOURNIAIRE, Julie (Université de Franche-Comté)

ID de Contribution: **21** Type: **Non spécifié**

Front propagation in system of mean field game type modelling thediffusion of knowledge.

jeudi 30 janvier 2025 09:45 (45 minutes)

The question under study, at large intermediate times, of a system,
proposed by the economists Lucas and Moll, aimed at describing the growth of an economy by means of diffusion of knowledge. The individual agents in the economy are supposed to share their time between learning and producing. They advance their knowledge by
learning from each other and via internal innovation, and their density obeys a forward in time equation of reaction-diffusion type. The learning strategy of the agents is based on the solution to a backward in time nonlocal Hamilton-Jacobi-Bellman equation that is
coupled to the equation for the agents density. The result is a system of the mean-field game type. An important parameter, that measures how successful the learning is, determines different asymptotic regimes. One of them, that does not
seem to have been identified in the literature, where most of the
agents spend almost all their time to learn, and whose large
intermediate time behaviour has a lot to do with Fisher-KPP
propgation, will be especially discussed.

Joint work with H. Berestycki, A. Novikov, L. Ryzhik

Orateur: ROQUEJOFFRE, Jean-Michel

ID de Contribution: **22** Type: **Non spécifié**

On the first positive position of a random walker

jeudi 30 janvier 2025 10:45 (45 minutes)

The distribution of the first positive position reached by a random walker starting from the origin plays a fundamental role in describing the statistics of extremes and records in one-dimensional random walks.
We present a comprehensive study of this distribution, with a particular focus on its moments and asymptotic behaviour, in the case where the step distribution is continuous and symmetric, encompassing both diffusive random walks and Lévy flights.

Orateur: M. GODRÈCHE, Claude

ID de Contribution: **23** Type: **Non spécifié**

Avalanches, clusters, and long range branching processes

jeudi 30 janvier 2025 11:30 (45 minutes)

Orateur: LE DOUSSAL, Pierre

ID de Contribution: **24** Type: **Non spécifié**

Stabilité en temps long de processus de Hawkes inhibés

jeudi 30 janvier 2025 14:00 (45 minutes)

Dans cet exposé, je présenterai quelques résultats récents sur le comportement à long terme des processus de Hawkes inhibés, à la fois en temps continu et en temps discret. En particulier, nous soulignerons le rôle complexe de l'inhibition dans la stabilité des processus de Hawkes.

Orateur: COSTA, Manon (Institut de Mathématiques de Toulouse)

ID de Contribution: **25** Type: **Non spécifié**

Law of large numbers and central limit theorem for branching processes

In this talk, we consider branching processes in infinite dimension; that is, a particle system where each particle follows Markov dynamics independently of the others between particle birth and death events. This includes growth-fragmentation processes, branching diffusions, Bellman-Harris processes… We will present recent results on the laws of large numbers and central limit theorems for empirical measure convergence. The latter are based on relatively weak assumptions about the underlying dynamics: the state space may be non-compact, the dynamics non-reversible, the branching non-local…

Orateur: CLOEZ, Bertrand

ID de Contribution: **26** Type: **Non spécifié**

Epidemic modeling and geodesics in layered directed configuration models

jeudi 30 janvier 2025 15:45 (45 minutes)

Some models of discrete-time epidemics can be studied in the larger setting of first-passage percolation in multitype directed configuration models, where edges have an integer length representing transmission delays. Through directed breadth-first explorations and coupling with multitype branching processes on countable state spaces, we study the distribution of geodesics between several random points, as the population tends to infinity. Under general conditions, we show convergence of the (shifted) length of geodesics to the first points of Cox processes with given intensities. Going back to our application, this allows us to obtain scaling limits for the "epidemic curve", extending previous works [Barbour and Reinert, 2013] to a discrete-time setting, under minimal assumptions. This is an ongoing joint work with Mathilde André.

Orateur: DUCHAMPS, Jean-Jil (Université de Franche-Comté, Besançon, France)

ID de Contribution: **27** Type: **Non spécifié**

Self-similarity: a new perspective in mathematical population genetics.

jeudi 30 janvier 2025 16:30 (45 minutes)

In this joint project with Arno Siri-Jégousse, we introduce a novel research program connecting the fields of mathematical population genetics and self-similar (SS) Markov processes in infinite dimensions. Specifically, we propose a shift in focus from the prevalent paradigm based on the branching property as a tool to analyze the structure of population models, to one based on the self-similarity property. By extending the well-known Lamperti transformation for SS Markov processes to the Banach-valued case, we generalized the celebrated work of Birkner et al. (2005) in population genetics. They describe the genealogies of populations modeled as a measure-valued alpha-stable branching process in terms of the subfamily of Beta coalescents. We describe the genealogies of SS populations whose total size evolves as any positive SS Markov process, in terms of general Lambda coalescents. Along the way we uncover a new duality structure between measure-valued processes on the one hand, and a pair composed of a Lambda-coalescent and a Lévy process on the other. This extends the well-known duality relation between Lambda Fleming-Viot processes and Lambda coalescents of Bertoin and Le Gall (2003).

Orateur: HERNANDEZ WENCES, Alejandro (LAAS - CNRS)

ID de Contribution: **28** Type: **Non spécifié**

Scaling limit of the Aldous-Broder chain on high-dimensional torii

vendredi 31 janvier 2025 09:00 (45 minutes)

The CRT is the scaling limit of the UST on the complete graph. The Aldous-Broder chain on a graph G=(V,E) is a MC with values in the space of rooted trees with vertices in V that is invariant under the uniform distribution on the space of rooted trees spanning G. In Evans, Pitman and Winter (2006) the so-called root growth with regrafting process (RGRG) was constructed. It was further shown that the suitable rescaled Aldous-Broder chain converges to the RGRG weakly with respect to the GH-topology. It was shown in Peres and Revelle (2005) that (up to a dimension depending constant factor) the CRT is also the G-weak scaling limit of the UST on the d-dimensional torus, $d \geq 5$. This result was recently strengthens in Archer, Nachmias and Shalev (2024) to convergence with respect to the GH-weak topology, and therefore also with respect to the GH-topology. In this talk we show that also the suitable rescaled Aldous-Broder chain on the high-dimensional torus converges to the RGRG weakly with respect to the GH-topology when initially started in the trivial rooted tree.

Orateur: WINTER, Anita

ID de Contribution: **29** Type: **Non spécifié**

Quenched critical percolation on Galton-Watson trees.

vendredi 31 janvier 2025 09:45 (45 minutes)

We consider critical percolation on a supercritical Galton- Watson tree with mean offspring m > 1. It is well known that the critical percolation probability for this model is 1/m and that the root cluster has the distribution of a critical Galton-Watson tree. For this reason, many properties of the cluster are well understood, such as aymptotics for long range survival probabilities, the size of the n-th generation conditioned on survival (the "Yaglom limit"), and convergence of the entire cluster to a branching process/stable tree. All of these results as stated are annealed, that is, we take the expectation with respect to the distribution of the tree and the percolation configuration simultaneously. The goal of this talk is to consider the quenched regime: are the same properties true for almost any realisation of the tree? We will see that this is indeed the case, although some scaling constants will depend on the tree.
Based on joint works with Quirin Vogel and Tanguy Lions

Orateur: ARCHER, Eleanor

ID de Contribution: **30** Type: **Non spécifié**

Asymptotic analysis and estimation of depolymerization models

vendredi 31 janvier 2025 10:45 (45 minutes)

The depolymerization (i.e. progressive shortening) of large molecules can be modeled by discrete Becker-Döring-type equations, or by continuous equations. In many applications, the dynamic nature of the experiments, as well as their nanometric scale, makes it difficult to estimate quantitatively, or even simply to decipher the mechanisms involved.
In this talk, I will discuss two problems inspired by experiments carried out by Human Rezaei's team at INRAE on the depolymerization of PrP protein fibers (responsible for prion diseases). The first, in collaboration with Philippe Moireau, is an inverse problem consisting in the estimation of the initial condition from the time dynamics of a moment of the solution. The second project, in collaboration with Klemens Fellner, Mathieu Mezache and Juan Velazquez, is the design and analysis of an oscillating depolymerization model - the standard models being unable to account for the sustained oscillations observed experimentally.

Orateur: DOUMIC, Marie

ID de Contribution: **31** Type: **Non spécifié**

Minorants convexes, processus de fragmentation/coalescence et limites d'échelle

vendredi 31 janvier 2025 11:30 (45 minutes)

Je présenterai une manière de construire des arbres aléatoires basée sur les minorants convexes de fonctions (aléatoires). Dans le cas Brownien, cette procédure est reliée au coalescent additif et à l'arbre continu Brownien, c'est-à-dire la limite d'échelle d'arbres uniformes, et de la fragmentation naturelle qui consiste à retirer les arêtes dans un ordre aléatoire.

En modifiant un peu la fonction de départ, on obtient un arbre lié au coalescent multiplicatif (graphes aléatoires) et à l'arbre couvrant minimum d'un graphe complet pondéré aléatoirement. Cette construction conduit aussi à la définition naturelle de nouveaux processus de coalescence/fragmentation liés à des graphes aléatoires contraints et/ou à la percolation d'invasion avec sources multiples.

L'exposé sera basé sur des travaux en commun avec J.-F. Marckert d'une part et Arthur Rousseau d'autre part.

Orateur: BROUTIN, Nicolas

ID de Contribution: **32** Type: **Non spécifié**

Lightning Talks

lundi 27 janvier 2025 17:00 (1h 20m)

ID de Contribution: **33** Type: **Non spécifié**

Mini cours: Scaling limits of branching random walks

mardi 28 janvier 2025 16:20 (1h 10m)

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Orateur: DONDERWINKEL, Serte

ID de Contribution: **34** Type: **Non spécifié**

Accueil

lundi 27 janvier 2025 08:30 (30 minutes)