Julien Verges

PhD student in Probability theory

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Cursus

Université de Tours, PhD under the supervision of Marie Théret and Jean-Baptiste Gouéré : "Asymptotic properties of greedy animals". Defense planned in the end of June. — 2022 - 2025

École normale supérieure, Paris, Mathematics department — 2018-2022

Université Paris-Saclay, master Mathématiques de l'aléatoire (Mathematics of randomness). — 2020-2021

Lycée Kléber, Strasbourg, preparatory classes MPSI / MP*. — 2015 – 2018

Internships

Institut Denis Poisson, UMR 7013. — April 2021 – August 2022

iGLOBES, UMI 3157: Evolutive response to an environmental variation. — Feb 2020 – April 2020

Research interests

Themes: Probability theory, Statistical physics.
Keywords: First-passage percolation, Greedy animals and paths, Large deviations, Stationary point processes.

Preprints

Concentration inequalities and large deviations for continuous greedy animals and paths, — Mar 2025

28 pages, available at https://hal.science/hal-04973217v1.

Abstract : Consider the continuous greedy paths model: given a d-dimensional Poisson point process with positive marks interpreted as masses, let $\mathrm{P}(\ell)$ denote the maximum mass gathered by a path of length ℓ starting from the origin. It is known that $\mathrm{P}(\ell)/\ell$ converges a.s. to a deterministic constant $\mathbf{P}$. We show that the lower-tail deviation probability for $\mathrm{P}(\ell)$ has order $\exp(\ell^2)$ and, under exponential moment assumption on the mass distribution, that the upper-tail deviation probability has order $\exp(-\ell)$. In the latter regime, we prove the existence and some properties — notably, convexity — of the corresponding rate function. An immediate corollary is the large deviation principle at speed ℓ for $\mathrm{P}(\ell)$. Along the proof we show an upper-tail concentration inequality in the case where marks are bounded. All of the above also holds for greedy animals and have versions where the paths or animals involved have two anchors instead of one.

Large deviation principle at speed n for the random metric in first-passage percolation, — Dec 2024

42 pages, available at https://arxiv.org/abs/2412.03320.

Abstract : Consider standard first-passage percolation on $\mathbb{Z}^d$. We study the lower-tail large deviations of the rescaled random metric $\widehat{\mathbf{T}}_n$ restricted to a box. If all exponential moments are finite, we prove that $\widehat{\mathbf{T}}_n$ follows the large deviation principle at speed n with a rate function J, in a suitable space of metrics. Moreover, we give three expressions for $J(D)$. The first two involve the metric derivative with respect to D of Lipschitz paths and the lower-tail rate function for the point-point passage time. The third is an integral against the 1-dimensional

Hausdorff measure of a local cost. Under a much weaker moment assumption, we give an estimate for the probability of events of the type $\{\widehat{\mathbf{T}}_n \leq D\}$.

Law of large numbers for greedy animals and paths in a Poissonian environment, Oct 2024

13 pages, available at https://arxiv.org/abs/2410.15771.

Abstract : We study two continuous and isotropic analogues of the model of greedy lattice animals introduced by Cox, Gandolfi, Griffin and Kesten in 1993-94. In our framework, animals collect masses scattered on a Poisson point process on $\mathbb{R}^d$, and are allowed to have vertices outside the process or not, depending on the model. The author proved in a precedent paper a more general setting that for all u in the Euclidean open unit ball, the mass of animals with length ℓ, containing 0 and ℓu satisfies a law of large numbers. We prove some additional properties in the Poissonian case, including an extension of the functional law of large numbers to the closed unit ball, and study strict monotonicity of the limiting function along a radius. Moreover, we prove that a third, penalized model is a suitable interpolation between the former two.

Law of large numbers for greedy animals and paths in an ergodic environment, Sept 2024

38 pages, available at https://arxiv.org/abs/2409.14773.

Abstract : Consider a family of random masses $\mathbf{m}(v)$ indexed by vertices of the lattice $\mathbb{Z}^d$. In the case where the masses are i.i.d. and satisfy a certain moment condition, it is known that there exists a deterministic $A \geq 0$ such that the maximal mass A_n of an animal containing 0 with cardinal n satisfies $A_n/n \to A$ when $n \to \infty$, almost surely. The same also goes for self-avoiding paths. We extend this result to the case where the family of masses is an ergodic marked point process, with a suitable definition for animals in this context. Special cases include the initial model with ergodic instead of i.i.d. masses and marked Poisson point processes. We also discuss some sufficient or necessary conditions for integrability.

Large deviation principle at speed n^d for the random metric in first-passage percolation, April 2024

79 pages, available at https://arxiv.org/abs/2404.09589.

Abstract : We consider the standard first passage percolation model on $\mathbb{Z}^d$ with bounded and bounded away from zero weights. We show that the rescaled passage time $\widetilde{\mathbf{T}}_n$ restricted to a compact set X satisfies a large deviation principle (LDP) at speed n^d in a space of geodesic metrics, i.e. an estimation of the form $\mathbb{P}\left(\widetilde{\mathbf{T}}_{n,X} \approx D\right) \approx \exp\left(-I(D)n^d\right)$ for any metric D. Moreover, $I(D)$ can be written as the integral over X of an elementary cost. Consequences include LDPs at speed n^d for the point-point passage time, the face-face passage time and the random ball of radius n. Our strategy consists in proving the existence of $\lim_{n\to\infty} -\frac{1}{n^d}\log \mathbb{P}\left(\widetilde{\mathbf{T}}_{n,[0,1]^d} \approx g\right)$ for any norm g with a multidimensional subaddivity argument, then using this result as an elementary building block to estimate $\mathbb{P}\left(\widetilde{\mathbf{T}}_{n,X} \approx D\right)$ for any metric D.

Teaching duties

Université de Tours – current year 2024-2025

Course: Analysis for undergrad math students (36h).
Tutorials: Algebra for undergrad math students (28h) (scheduled at the second semestre).

Université de Tours – previous years 2022-2024

Tutorials: Analysis for undergrad math students (36h/year).

Tutorials: Python for undergrad math students (18h/year).

Tutorials: Statistics for undergrad biology students (10h/an).

Talks

PhD students' seminar at IDP, Tours. 2024

Nanterre's Probability seminar, Nanterre

IDP young researchers' week , Nouan-le-Fuzelier. 2023
PhD students' seminar at IDP, Tours
PPPP Conference (Percolation and first-passage percolation), Grenoble.
IDP young researchers' week , Nouan-le-Fuzelier. 2021
SPACE seminar, Tours.

Languages

French : maternal
English : fluent
German : beginner

Associative activities

Comedian in the "Tite Compagnie", Chambray-lès-Tours 2021-...