SIPS 2026 – Abstract Book

The Workshop ”Statistical Inference for Particle Systems”
April 7–8, 2026, Paris and Évry, France

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Tuesday, April 7

IHP, Paris – salle Pierre Grisvard

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16:00–16:45	Fabienne Comte
16:45–17:15	Théophile Le Gall

Wednesday, April 8

Université Évry Paris-Saclay – bât. IBGBI, Petit amphi

09:30–10:00	Hoang-Long Ngo (via videoconference)
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(3e étage, salle des séminaires du LaMME)

11:15–11:35	Charlotte Dion-Blanc
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Talk 1: Marc Hoffmann (Université Paris Dauphine-PSL)

Title: Statistical inference in mean-field particle systems and PDEs: some questions and remarks

Abstract. Evolution models in applications are often analyzed via PDEs, interpreted as a macroscopic description of the phenomenon of interest. This classical approach is nevertheless challenged by empirical data for model validation, especially when the phenomenon of interest does not depend on well established physical laws. In particular the statistical inference of parameters (estimation and testing) requires an underlying stochastic model. This is usually treated via some addition of noise, sometimes artificially and always a bit arbitrarily. Relying on some specific examples that appear in population biology (cell growth, human demography) or agent-based models in economy, we propose an alternative approach. Starting from a microscopic stochastic model that can be partially observed and for which the PDE of interest is a mean-field limit, the intrinsic statistical noise becomes the fluctuation between the empirical measure of the particle system and the solution of the PDE. We will outline a rigorous statistical program in this setting and will give some results on McKean-Vlasov models that emphasize the interest of our approach.

Talk 2: Yating Liu (Université Paris Dauphine-PSL)

Title: A statistical approach for simulating the density solution of a McKean-Vlasov equation
(Joint work with Marc Hoffmann)

Abstract. We prove convergence results of the simulation of the density solution to the McKean-Vlasov equation, when the measure variable is in the drift. Our method builds upon adaptive nonparametric results in statistics that enable us to obtain a data-driven selection of the smoothing parameter in a kernel-type estimator. In particular, we give a generalized Bernstein inequality for Euler schemes with interacting particles and obtain sharp deviation inequalities for the estimated classical solution. We complete our theoretical results with a systematic numerical study and gather empirical evidence of the benefit of using high-order kernels and data-driven smoothing parameters.

Talk 3: Fabienne Comte (Université Paris Descartes)

Title: Nonparametric moment method for scalar McKean-Vlasov stochastic differential equations
(Joint work with Valentine Genon-Catalot and Catherine Larédo)

Abstract. We study the nonparametric estimation of both the potential and the interaction terms of a McKean-Vlasov stochastic differential equation (SDE) in stationary regime from a continuous observation on a time interval $[0, T]$, with asymptotic framework $T \to +\infty$. The problem is quite different from the case of usual diffusions with no interaction term and the observation of only one sample path is not enough to estimate both

functions. We consider the observation of four i.i.d. sample paths. The observation of two sample paths could be enough at the cost of much more computations. Estimators of the potential and the interaction functions are built using a combination of a moment method and a projection method on sieves. We define a specific risk fitted to this estimation problem and obtain a bound for it. A nonparametric estimator of the invariant density also is proposed. The method is implemented on simulated data for several examples of McKean-Vlasov SDEs and a model selection procedure is experimented.

Talk 4: Théophile Le Gall (Université Paris Dauphine-PSL)

Title: Inference on Common Noise in Interacting Particle Systems

Abstract. Inference on common noise is considered in systems of interacting particles observed over a finite time horizon. The dynamics involve both idiosyncratic noise components, acting independently on each particle, and a common noise component that induces dependence across the system. The objective is to detect and quantify the presence of this common source of randomness from joint observations of particle trajectories. The analysis relies on quadratic variation arguments that allow the contribution of the common noise to be isolated, while idiosyncratic noise terms cancel exactly. This separation property follows from the orthogonality structure of independent Brownian motions and holds without approximation.
Asymptotic results are established as the observation grid becomes increasingly fine, including central limit theorems under the null hypothesis of absence of common noise and under relevant class of alternatives. These results lead to asymptotically valid statistical procedures for inference on common noise. The framework accommodates time and state dependent coefficients and applies to a broad class of interacting particle systems, including McKean–Vlasov-type models.

Talk 5: Hoang-Long Ngo (Hanoi National University of Education)

Title: Numerical schemes for a class of generalized radial Dunkl processes (Joint work with Dai Taguchi (Kansai University) and Do Minh Thang (The Chinese University of Hong Kong, Shenzhen))

Abstract. The class of Dunkl processes encompasses many well-known models in mathematical finance and mathematical physics, including Bessel processes, Dyson's Brownian motions, and Wishart processes. In this talk, we study a generalized class of radial Dunkl processes governed by stochastic differential equations (SDEs) with singular drift and multiplicative noise. We first establish the existence and uniqueness of strong solutions and derive bounds for negative moments of the solution. We then propose and analyze numerical approximation schemes for these SDEs, providing appropriate convergence guarantees.

Talk 6: Chiara Amorino (Universitat Pompeu Fabra Barcelone)

Title: Kinetic interacting particle system: parameter estimation from complete and partial discrete observations

Abstract. We study the estimation of drift and diffusion coefficients in a two-dimensional system of N interacting particles modeled by a degenerate stochastic differential equation. We consider both complete and partial discrete observation cases over a fixed time horizon $[0, T]$ and propose novel contrast functions for parameter estimation. In the partial observation scenario, we tackle the challenge posed by unobserved velocities by introducing a surrogate process based on the increments of the observed positions. This requires a modified contrast function to account for the correlation between successive increments. Our analysis demonstrates that, despite the loss of Markovianity due to the velocity approximation in the partial observation case, the estimators converge to a Gaussian distribution (with a correction factor in the partial observation case). The proofs are based on Ito-like bounds and an adaptation of the Euler scheme for both the drift and diffusion components. Additionally, we provide insights into Hörmander's condition, which helps establish hypoellipticity in our model within the framework of stochastic calculus of variations.

Talk 7: Charlotte Dion-Blanc (Université Sorbonne Paris Nord)

Title: Who Drives the System? Classifying Mean-Field Particle Systems from Trajectory Data
(Joint work with Christophe Denis and Yating Liu)

Abstract. We investigates a model of N interacting particles in the limit as N goes to infinity. The central question we address is the following: assuming that the system exhibits K distinct classes of behavior, how can a newly observed particle be reliably assigned to one of these classes on the basis of its trajectory?

We consider interacting particle systems driven by stochastic differential equations with Brownian noise, in a mean-field regime where particles become asymptotically independent and their dynamics are governed by a McKean-Vlasov equation. The drift function, depends on a label Y that is common to the whole system and is modeled as a random variable taking values in $[K]$.

To tackle this challenging problem, we introduce a novel methodology based on a plug-in classification rule and study the convergence rate of the associated excess risk. In particular, we highlight the trade-off between the size of the learning system, that of the test sample, and the observation frequency. Since the procedure relies on estimating the unknown drift functions that distinguish the dynamics across classes, we also address this key issue by developing a nonparametric estimator based on B-splines from trajectory data.

Talk 8: Augustin Puel (Université Alpes-Côte d'Azur & Universitat Pompeu Fabra Barcelone)

Title: Drift Estimation for N Particle Mean-Field Models with Fractional Noise under Discrete Observations

Abstract. The parametric estimation of mean field models driven by Brownian motion has been widely studied in recent years. In this vein, we extend this study to models driven by fractional Brownian motion. In this presentation we will introduce a new estimator of the drift parameter based on discrete observations of an N particles mean field model with additive noise driven by a fractional Brownian motion. Because the process lacks both martingale and Markov properties, our analysis relies on pathwise arguments. We investigate the asymptotic properties of the model and of the estimator in for the Hurst parameter $H > 1/3$. Moreover, we explain how to jointly estimate the diffusion coefficient and the Hurst parameter along with the drift.

Talk 9: Mark Podolskij (Université de Luxembourg)

Title: On nonparametric estimation of the interaction function in particle system models

Abstract. This talk delves into the challenging problem of nonparametric estimation for the interaction function within diffusion-type particle system models. We introduce a new estimation method based on empirical risk minimization. Our study encompasses an analysis of the stochastic and approximation errors associated with the proposed procedure, along with an examination of a minimax lower bound. In particular, we will introduce a metric, which naturally corresponds to the underlying empirical risk minimization, under study the estimation error with respect to this metric. In a second step, we investigate convergence rates in the conventional L^2-norm and discuss their optimality in some cases.

Talk 10: Grégoire Szymanski (Université de Luxembourg)

Title: Mean-Field Limits for Nearly Unstable Hawkes Processes

Abstract. In this paper, we establish general scaling limits for nearly unstable Hawkes processes in a mean-field regime by extending the method introduced by Jaisson and Rosenbaum. Under a mild asymptotic criticality condition on the self-exciting kernels $\{\phi^n\}$, specifically $\|\phi^n\|_{L^1} \to 1$, we first show that the scaling limits of these Hawkes processes are necessarily stochastic Volterra diffusions of affine type. Moreover, we establish a propagation of chaos result for Hawkes systems with mean-field interactions, highlighting three distinct regimes for the limiting processes, which depend on the asymptotics of $n(1 - \|\phi^n\|_{L^1})^2$. These results provide a significant generalization of the findings by Delattre, Fournier and Hoffmann.

Talk 11: Yasan Odeh (Université Alpes-Côte d'Azur & Universitat Pompeu Fabra Barcelone)

Title: Nonparametric drift estimation for interacting particle systems driven by additive fractional noise

Abstract. We introduce a projection estimator for the nonparametric problem of estimating the interaction potential φ of an interacting particle system driven by fractional Brownian motion with Hurst parameter $H > 1/2$.
More precisely, we observe N interacting particle trajectories on the time interval $[0, T]$ and show that our estimator is asymptotically consistent for $N \to \infty$.
While projection estimators have previously been studied for fractional SDEs with i.i.d. trajectory observations as well as for interacting particle systems (IPS)driven by standard Brownian motion, to the best of our knowledge this specific setting has not been addressed yet and poses new challenges.
To adapt existing techniques to this framework, we introduce a new matrix concentration inequality which is based on a Girsanov transformation of something we refer to as the semi-dependent particle system. This approach might be of independent interest, as it can also be used to generalize previously introduced concentration results for IPS. Ultimately, this concentration inequality will allow us to recover known rates for the Brownian motion case when $H \searrow 1/2$.
Finally, we develop a novel fixed-point approach that relies on iteratively shrinking the time horizon $T_N \to 0$ as $N \to \infty$ in order to introduce an estimation procedure which allows to control the additional Malliavin derivative term appearing in the fractional case.

Talk 12: Aline Duarte (Universidade de São Paulo, Brazil)

Title: Nonparametric estimation of the jump rate in mean field interacting systems of neurons

Abstract. In this talk we consider finite systems of N interacting neurons described by non-linear Hawkes processes in a mean field frame. Neurons are described by their membrane potential. They spike randomly, at a rate depending on their potential. In between successive spikes, their membrane potential follows a deterministic flow. We estimate the spiking rate function based on the observation of the system of N neurons over a fixed time interval $[0; t]$. Asymptotic are taken as N, the number of neurons, tends to infinity. We introduce a kernel estimator of Nadaraya-Watson type and discuss its asymptotic properties with help of the deterministic dynamical system describing the mean field limit. We compute the minimax rate of convergence in a L^2-error loss over a range of Holder classes and obtain the classical rate of convergence $N^{2\beta(2\beta+1)}$, where β is the regularity of the unknown spiking rate function. This is a joint work with Kádmo Laxa, Eva Löcherbach and Dasha Loukianova.
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