Modèles et contrôle à champ moyen

- Huyên Pham (Université Paris Cité)

  Title: Contrôle de systèmes en interaction

  Abstract: Cet exposé est une introduction au contrôle de systèmes au sein de grandes populations d'agents en interaction. Ce domaine a connu une forte expansion ces dernières années, en grande partie grâce à l'émergence de la théorie des jeux à champ moyen, inspirée de la physique statistique. Nous explorerons les principaux outils mathématiques développés pour étudier ces problèmes complexes en dimension infinie. En outre, nous présenterons les avancées récentes d'une part pour leur résolution numérique par des méthodes d'apprentissage automatique, d'autre part pour prendre en compte l'hétérogénéité des agents dans une description plus réaliste des dynamiques contrôlées de systèmes en interaction.

- Samuel Daudin (Université Nice)

  Title: Stable Optimal Parameters for Deep and Wide Resnets Trained with Langevin Dynamics

  Abstract: Performing regression tasks with deep neural networks can be modeled as an optimal control problem for an ordinary differential equation. We investigate a relaxation of this problem where controls are taken to be probability measures over the parameter space and the cost involves an additional entropy penalization. We are particularly interested in the stability of the optimal parameters – where stability is understood in terms of unique solvability of a certain linearized system of pdes. We show that, for a lot of initial data (in terms of the initial distribution of the features), there is actually a unique stable global minimizer in the control problem. Moreover we prove that the (continuous analog of the) gradient descent with backpropagation converges exponentially fast when initialized nearby a stable minimizer. This is a joint work with François Delarue.

- Zhenjie Ren (Université Paris Dauphine)

  Title: Self-interacting approximation to McKean-Vlasov long time limit

  Abstract: Motivated by the mean-field optimization model of the training of two-layer neural networks, we propose a novel method to approximate the invariant measures of a class of McKean-Vlasov diffusions. We introduce a proxy process that substitutes the mean-field interaction with self-interaction through a weighted occupation measure of the particle's past. If the McKean-Vlasov diffusion is the gradient flow of a convex mean-field potential functional, we show that the self-interacting process exponentially converges towards its unique invariant measure close to that of the McKean-Vlasov diffusion. As an application, we show how to learn the optimal weights of a two-layer neural network by training a single neuron.

- Yoann Tardy (École Polytechnique)

  Title: Weak convergence of the empirical measure for the Keller-Segel model in both subcritical and critical cases

  Abstract: We show the weak convergence, up to extraction of a subsequence, of the empirical measure for the Keller-Segel system of particles in both subcritical and critical cases, for general initial conditions. This particle system consists of N planar Brownian motions interacting through a Coulombian attractive force, which is quite singular. In the subcritical case, a stronger result has been established by Bresch-Jabin-Wang at the price of two simplifications: the whole space $\mathbb{R}^2$ is replaced by a torus and the initial condition is assumed to be regular. In the subcritical case, our proof is fairly straightforward: we use a *two particles* moment argument, which shows that particles do not aggregate in finite time, uniformly in the number of particles. The critical case requires more work.