Strong propagation of chaos for systems of interacting particles with nearly stable jumps

Eva LÖCHERBACH, Statistique, Analyse et Modélisation Multidisciplinaire - Paris

Dasha LOUKIANOVA, Laboratoire de Mathématiques et Modélisation d'Évry - Evry

Elisa MARINI, CEREMADE - Paris

We consider a system of N interacting particles, described by SDEs driven by Poisson random measures, where the coefficients depend on the empirical measure of the system. Every particle jumps with a rate depending on its position. When this happens, all the other particles of the system receive a same random kick distributed according to a heavy tailed random variable belonging to the domain of attraction of an α-stable law and scaled by $N^{-1/\alpha}$, $\alpha \in (0, 2) \setminus \{1\}$. We call these jumps collateral jumps. Moreover, in case $0 < \alpha < 1$, the jumping particle itself undergoes a macroscopic, main jump. Similar systems are employed to model families of interacting neurons and, in that context, main and collateral jumps represent respectively the hyperpolarization of a neuron after a spike and the synaptic inputs received by post-synaptic neurons from pre-synaptic ones. We prove that our system has the conditional propagation of chaos property : as $N \to +\infty$, the finite particle system converges to an infinite exchangeable system which obeys a McKean-Vlasov SDE driven by an α-stable process, and particles in the limit system are independent, conditionally on the driving α-stable process.

Contact : marini@ceremade.dauphine.fr