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The convergence problem in mean-field control theory and related PDEs over the space of probability measures

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The goal of this talk is to discuss recent progress in the convergence problem in mean-field control theory.

We are interested in control problems involving a large number of (controlled) interacting particles subject to independent noises of Brownian type. When the number of particles tends to infinity, the problem simplifies into a control problem of mean-field type, set on the space of probability measures over the euclidean space. I will present some recent progress in the quantitative analysis of this convergence. More precisely I will discuss an approach based on a suitable mollification of the value function of the limiting problem. By dynamic programming, this value function solves in a weak viscosity sense a semi-linear Hamilton-Jacobi equation over the set of probability measures. We regularize it via sup-convolution in a well-chosen functional Hilbert space in order to produce approximations that are almost classical (sub)-solutions to the dynamic programming equation. Projecting these approximations in finite dimension, we can compare them with the value functions of the particle systems and obtain sharp rates of convergence.

This is based on a joint works with François Delarue, Joe Jackson and Ben Seeger.

Orateur: DAUDIN, Samuel (Université Côte d'Azur)