Stochastic optimal control of McKean-Vlasov systems

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Description of the project

Control of McKean-Vlasov (MKV) equation is a novel class of stochastic optimization problems, basically motivated by the behavior of large population in interaction, and finds numerous relevant applications in economics/finance (systemic risk), sociology (social networks), physics or biology. MKV control problem also arises when considering cost/performance criteria with nonlinear dependence on the law of the controlled state process, typically in Markowitz mean-variance portfolio selection problem, and has important practical applications in risk management under constraints.
The goal of this project is to study and implement a numerical method based on dynamic programming and control randomization recently developed in [1], [2] for MKV control problem, which leads to the time discretization and simulation of constrained backward stochastic differential equations (BSDEs) with forward McKean-Vlasov stochastic differential equation (MKVSDE). During this project, two approaches will be implemented and compared for the simulation of the forward MKVSDE : a decoupling scheme and an interacting particle method. Next, the computation of the nested condition expectations arising from the BSDEs will be performed either by empirical regression or quantization as presented in the lectures of this summer school. Numerical experiments will be particularly dedicated towards a practical application in optimal production in energy markets.

References

[1] Bayraktar E., Cosso A. and H. Pham (2016) : « Randomized dynamic programming principle and Feynman-Kac representation for optimal control of McKean-Vlasov dynamics », arXiv : 1606.08204, to appear in *Transactions of the American Mathematical Society*.

[2] Pham H. and X. Wei (2016) : « Dynamic programming for optimal control of stochastic McKean-Vlasov dynamics », arXiv 1604.04057, to appear in *SIAM Journal on Control and Optimization.*