Stochastic maximum principle for optimal control of non exchangeable mean field systems

Samy Mekkaoui*[1]

[1]Ecole Polytechnique – EcolePolytechnique, Ecole Polytechnique – France

Abstract

We study the Pontryagin maximum principle by deriving necessary and sufficient conditions for a class of optimal control problems arising in non-exchangeable mean field systems, where agents interact through heterogeneous and asymmetric couplings. We introduce two formulations: a strong formulation, leading to a system of coupled forward–backward stochastic differential equations (FBSDEs), and a label-state formulation, which yields a label-parametrized FBSDE of non-exchangeable mean field type. Under suitable assumptions, we establish the well-posedness of the resulting system. As an illustration, we analyze the linear–quadratic case, in which the optimal control is characterized by an infinite-dimensional system of Riccati equations. We also propose numerical methods to compute the optimal control and apply it to a systemic risk model with heterogeneous banks, highlighting the impact of agent heterogeneity on optimal risk-mitigation strategies.

*Speaker