

PHD COURSE

Title: Optimal control of large systems and mean-field games

Speaker : Prof. Pierre Cardaliaguet (Université Paris Dauphine)

Dates: 25 hours 11 April to 20 May 2024

For Information: Alessio Porretta (porretta@mat.uniroma2.it)

SCHEDULE

Giovedì	11 aprile	(Aula D'Antoni) h15-18
Lunedì	15 aprile	(Aula D'Antoni) h15-18
Giovedì	18 aprile	(Aula D'Antoni) h15-18
Lunedì	22 aprile	(Aula D'Antoni) h15-18
Giovedì	2 maggio	(Aula D'Antoni) h15-18
Lunedì	6 maggio	(Aula D'Antoni) h15-18
Lunedì	13 maggio	(Aula D'Antoni) h15-18
Mercoledì	15 maggio	(Aula D'Antoni) h15-18
Lunedì	20 maggio	(Aula D'Antoni) h15-18

Program:

The course is devoted to study the optimal control of systems consisting in a large number of "particles" (vehicles, drones, agents,...). This question has attracted a lot of attention in the last two decades, with motivations in engineering, economy and finance. Mathematically, it involves some analysis on space of measures, partial differential equations, calculus of variations and mean field theories.

Outline of the course:

1. Analysis in the space of measures (Wasserstein distances, differential calculus).
2. Optimal control of the continuity equation and the Fokker-Planck equation (existence of a solution, characterization, value function and Hamilton-Jacobi equations in the space of measures).
3. Applications to systems with a large (but finite) number of particles.
4. Link with mean-field game theory.

Main references:

1. [1] A. Bensoussan, J. Frehse, Yam: Mean Field Games and Mean-field type control theory, Springer Briefs in Math., Springer New York, 2013.
2. [2] P. Cardaliaguet, F. Delarue, J.-M. Lasry e P.-L. Lions: “The master equation and the convergence problem in mean-field games”, Annals of Math. Studies (Princeton University Press), 2019.
3. [3] P. Cardaliaguet, A. Porretta: “An introduction to Mean-Field Game theory”, in: Mean field games, 1-158, Lecture Notes in Math. 2281 (Fond. CIME/CIME Found. Subser.), Springer, Cham. 2020.
4. [4] J.-M. Lasry, P.-L. Lions: Jeux à champ moyen I & II; Comptes Rendus Math. Acad. Sci. Paris 343 (2006).