Laboratoire de Mathématiques et Informatique pour la Complexité et les Systèmes
MICS

Présente

L'AVIS DE SOUTENANCE

De **Monsieur Gaoyue Guo,**
Laboratoire MICS de CentraleSupélec, qui soutiendra son mémoire en vue de l'obtention de l'Habilitation à Diriger des Recherches sur le thème :

"Constrained Optimal Transport and Particle Systems : Irregular and Quantum"

Le vendredi 13 mars 2026 à 10h

A l'école CentraleSupélec, au Théâtre Joël ROUSSEAU – bâtiment Bouygues

Membres du jury :

- Prof. Mathias Beiglböck, University of Vienna (Rapporteur)
- Prof. Pierre Rouchon, Mines Paris (Rapporteur)
- Prof. Francesco Russo, ENSTA (Rapporteur)
- Prof. Bruno Bouchard, Université Paris-Dauphine
- Prof. François Golse, Ecole Polytechnique
- Prof. Benjamin Jourdain, Ecole des Ponts
- Prof. Stéphane Menozzi, Université d'Evry
- Prof. Christoph Reisinger, University of Oxford

Résumé :

The common thread of this work is the development of mathematical frameworks for analyzing complex systems, stochastic or quantum, subject to constraints, singularities, and high-dimensional effects. The manuscript is organized

around three main research directions which, although rooted in different communities, are unified by tools from analysis, probability, control theory, optimal transport, and mean-field limits.

The first research axis concerns optimal transport under additional constraints, extending classical optimal transport through martingale constraints motivated by robust pricing in finance. My contributions range from general theoretical developments, including computational approaches and sliced Wasserstein-type variants, to more specific investigations connecting constrained transport with entropy, stochastic control and PDEs, thereby illustrating the unifying role of optimal transport across seemingly unrelated problems.

The second axis focuses on irregular interacting particle systems, motivated by models of financial networks as well as biological/chemical populations. In these models, particles represent interacting components whose dynamics may generate cascades of absorption and abrupt systemic transitions. I establish sufficient conditions preventing systemic failure and introduce quantitative notions of systemic robustness based on survival proportions. Further results address propagation of chaos for absorbing particle systems, allowing large interacting dynamics to be approximated by tractable mean-field limits. Extensions incorporating mutual holding mechanisms and allocation policies reveal new feedback effects and lead to alternative mean-field formulations.

The third axis studies quantum particle systems under indirect measurements, whose conditional dynamics are described by stochastic master (Belavkin) equations. Unlike classical systems, quantum dynamics involve entanglement, preventing a direct description of individual behavior. My work adapts mean-field techniques from closed systems, including BBGKY hierarchy, Pickl quantity, Wick calculus, etc., to establish quantum propagation of chaos results in both finite and infinite dimensions, for bounded and unbounded Hamiltonians. These developments contribute toward a probabilistic and analytical theory of large monitored quantum systems linking filtering and collective interactions.

Taken together, these works outline a coherent research program: understanding constrained optimal transport problems, analyzing singular interacting particle systems and their mean-field limits, and extending these ideas to quantum systems where measurement and entanglement introduce fundamentally new challenges.