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MS18 Modeling and Control of Multi-agent Systems

Sparse Mean-Field Optimal Control

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Abstract: Starting with the seminal papers of Reynolds (1987), Vicsek et. al. (1995) Cucker-Smale (2007), there has been a flood of recent works on models of self-alignment and consensus dynamics. Self-organization has been so far the main driving concept. However, the evidence that in practice self-organization does not necessarily occur leads to the natural question of whether it is possible to externally influence the dynamics in order to promote the formation of certain desired patterns. Once this fundamental question is posed, one is also faced with the issue of defining the best way of obtaining the result, seeking for the most economical manner to achieve a certain outcome. The first part of this talk precisely addresses the issue of finding the sparsest control strategy for finite dimensional models in order to lead us optimally towards a given outcome. In the second part of the talk we introduce the rigorous limit process connecting finite dimensional sparse optimal control problems with ODE constraints to an infinite dimensional optimal control problem with a constraint given by a system of ODE for the leaders coupled with a PDE of Vlasov-type, governing the dynamics of the probability distribution of the followers. The technical derivation of the sparse mean-field optimal control is realized by the simultaneous development of the mean-field limit of the equations governing the followers dynamics together with the Gamma-limit of the finite dimensional sparse optimal control problems.