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MS18 Modeling and Control of Multi-agent Systems

Invisible sparse control of self-organizing agents leaving unknown environments

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Abstract: In this talk we consider a new model for crowd dynamics, where agents account two phases: an exploration phase and an evacuation phase, the aim is to introduce a control, adopting a bottom-up approach, ables to steer the agent system towards the target exit. To this end we consider few agents (leaders) who are hidden in the crowd, and they are not recognized by the mass as special, and whose dynamic is governed by a control strategy.
We present two different level of descriptions for the crowd. First we introduce a microscopic model characterized by social forces and a random term accounting for the unknown environment and the limited visibility. We also consider both metric and topological interactions to avoid unnatural all-to-all interactions. Second we derive an equivalent mesoscopic model, using a Boltzmann approach based on binary interaction approximation, showing the connection between the microscopic model and the obtained Vlasov-Fokker-Planck type equation. In both cases the crowd dynamic is coupled with the one of few microscopic leaders, moving accordingly the solution of a control problem.
Several numerical tests validate the presented approach in both micro-micro and meso-micro settings, showing that controlling few invisible microscopic agents is enough to steer the crowd toward the exits, so to ease the evacuation and limit clogging effects. Locally-optimal behavior of leaders are computed by means of the model predictive control (MPC) technique and a modified compass search.