Karlstad Applied Analysis Seminar (2020)

Alexander Aurell, Princeton University, USA

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On modeling the behavior of pedestrians near walls and the mean-field approach to crowd dynamics

Abstract

In macroscopic models for the motion of pedestrian crowds, the interaction with walls is often modelled with Neumann-type boundary conditions on the pedestrian density. The interpretation of this type of constraints on a microscopic (individual) level is a pedestrian path reflecting at the walls. Pedestrians however do not reflect on walls, their movement is slowed down by the impact and they need some time to choose a new direction of motion. In the mean-field approach to pedestrian crowd modeling the interaction between pedestrians is assumed to be symmetric and weak, and can be approximated by an interaction with a mean-field (typically a functional of the pedestrian density). One of the main attractions of the mean-field approach is that it connects the macroscopic (pedestrian density) and the microscopic (pedestrian path) description of a crowd. Optimal control in the mean-field approach is well understood for density problems with Neumann conditions. However, for more elaborate mean-field couplings, it is not understood how to control the corresponding paths (reflected SDEs). In this presentation a system of SDEs of mean-field type will be introduced that aims to resolve the two concerns stated above. It lets pedestrians spend some time at the boundary, move along the boundary, and choose new direction of motion when they re-enter the domain. The model is shown to have no strong so-

lution but a unique weak solution and it can be optimally controlled in the weak sense using a Pontryagin's type maximum principle.