Multi-agent Reinforcement Learning-based Pedestrian Dynamics Models for Emergency Evacuation

Abstract

While there are numerous successful models like social force model and agent-based models that address high-density crowds, there is glaring lack of effective modeling techniques targeted at low- to medium-density pedestrian situations. Furthermore, previous studies have focused on either pedestrians' route planning or pedestrians' physical movements without considering the interactions between these two levels. This project will integrate these two levels to dynamically plan routes and control pedestrian's movements during plan execution. The information of local environment and human behavioral characteristics is formulated into a reward matrix to re-plan pedestrians' path or adapt to the changes in the environments. This facilitates modeling of the nonlinear characteristics of the human decision-making processes beyond simple rule-based models. We will develop the computational modeling framework and simulate emergency evacuation of a midsize airport. We will develop reinforcement leaning model to learn local navigation behaviors and simulate dynamic pedestrian behaviors. This model will be utilized to determine intermediate goals for each pedestrian particle, which is a key input for the time evolution of pedestrian trajectories. The project outcome will lead to a multidisciplinary computational framework for understanding and modeling the human decision-making process and resulting actions in emergency evacuations.

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