

Interactive Multi-Agent Simulation for Physical and Virtual Worlds

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From record-setting crowds at rallies, robot swarms in the field, to avatars in social virtual reality (VR), our world is experiencing a continuing rise of complex, distributed systems of independently moving entities. With potential applications such as predicting crowd panic, improving human-robot cooperation, enhancing social interactions, conceptualizing urban layout, computational models to analyze, understand, predict, reproduce, and control collective behaviors of complex dynamical systems are becoming critically important.

In this talk, we will present an overview of velocity-space planning algorithms to compute cooperative motion paths and behaviors for a group of independent agents, sharing the same physical world or virtual space. These techniques include optimization-based strategies for distributed collision avoidance, the principle of least effort for simulating crowds, and data-driven models for capturing differences in personalities. We will also describe related techniques needed to achieve accurate simulations of large-scale crowds and methods to validate simulations against real-world data and demonstrate how velocity-space motion planning can be applied to collision avoidance for distributed robotic systems. We will further illustrate on simulation of human-like crowds, with applications to computer animation, gaming, robotics, pedestrian dynamics, visual surveillance, and architectural analysis.

<http://gamma.cs.unc.edu/research/crowds/>