Modeling Crowd Dynamics

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Crowd Simulation

- Attempts to model the reaction of groups of agents, often with some social aspect, to an environment
- Often used to model human crowds in different environments for civil design purposes
- Are now essential in the design of evacuation protocols for large structures

Applications For Crowd Simulation

- Entertainment
  - Used in movies, television, and video games.
- Architecture and Civil Engineering
  - Analyze the movement of agents through modeled environments.
    - Analyze road network efficiency.
    - Building evacuation safety and efficiency
- Computer Science
  - Study AI models and behavior.

Visualization vs. Realism

- Visualization
  - Used to create entertaining backdrops for films and games
- Realism
  - Used to model how real people react to and traverse through environments in large groups
  - Requires careful models of human psychology
  - End goal is to be as accurate as possible
- Over the last decade, the separation has been diminishing

Realism

- Crowd Dynamics Consultants
  - Uses models to determine congestion and perform redesign using the results of crowd dynamics simulations

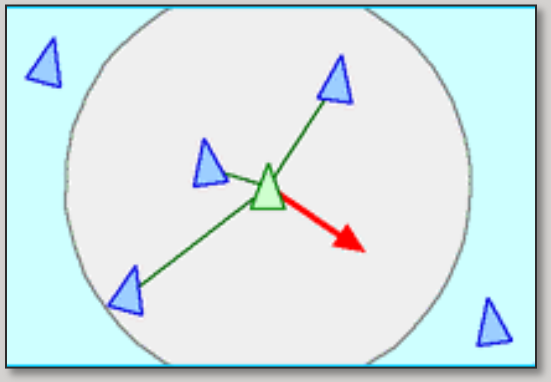
Approaches To Realistic Crowd Modeling

- Agent-based or microscopic
  - Uses individual agents to model the crowds
  - Requires many of the behaviors we have seen and covered for swarm intelligence
- Group-based or macroscopic
  - Models crowds via grouping
  - Example: treating transit as vehicle flow

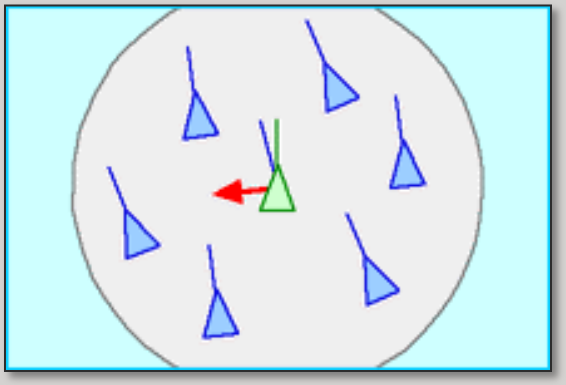
Swarm Intelligence in Crowds

- Many models use flocking to mimic human behavior
- Recall the paper we read on steering behavior, many approaches directly utilize the ideas thereof:

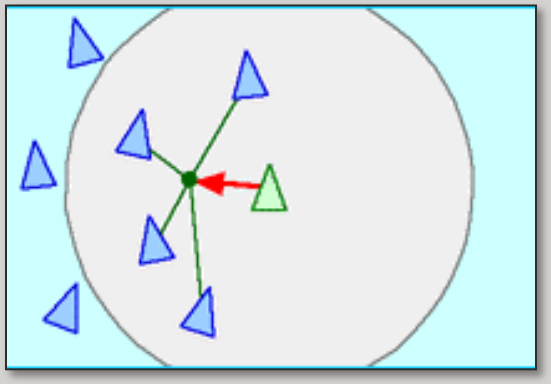
Separation



Alignment

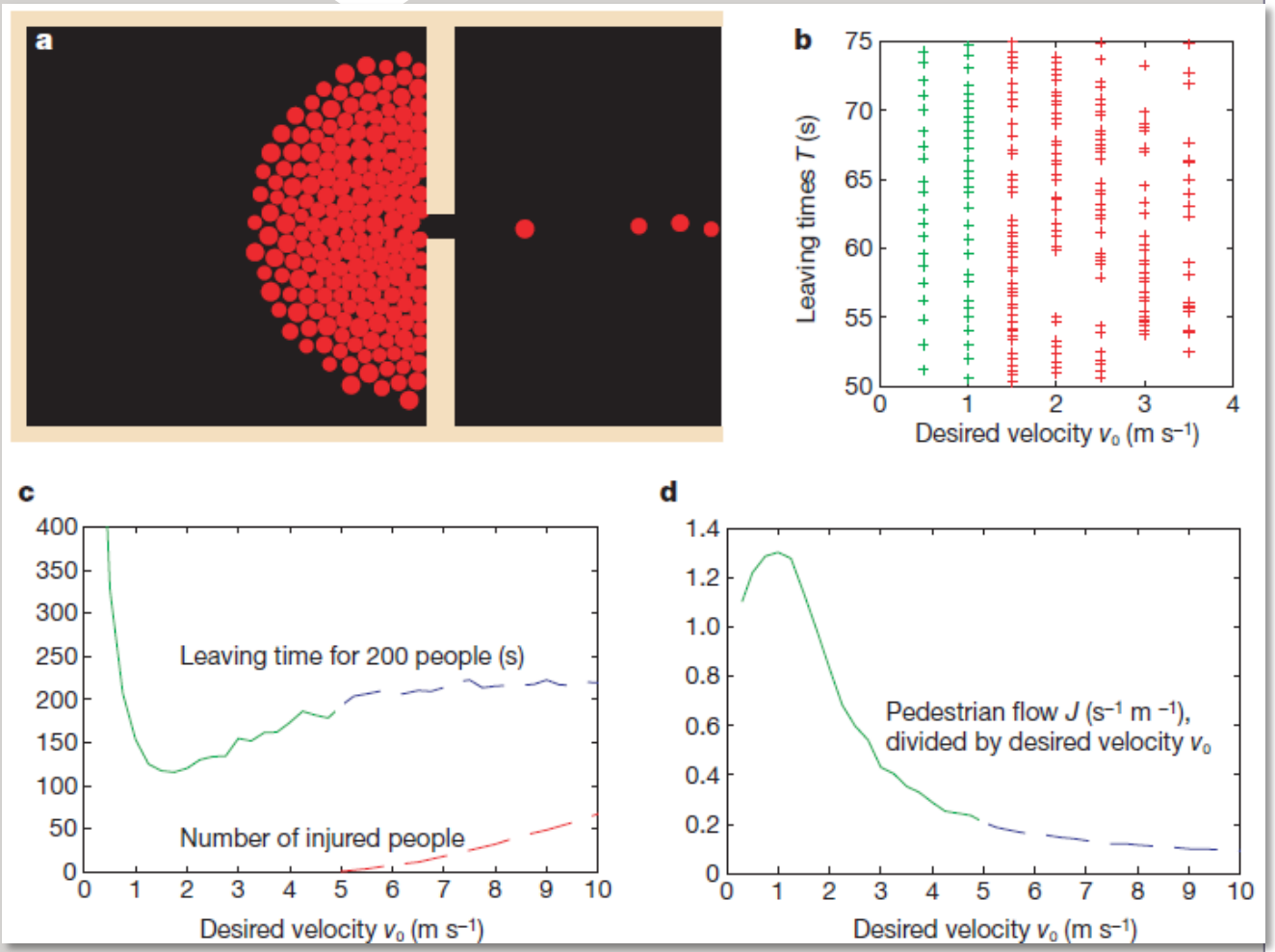


Cohesion

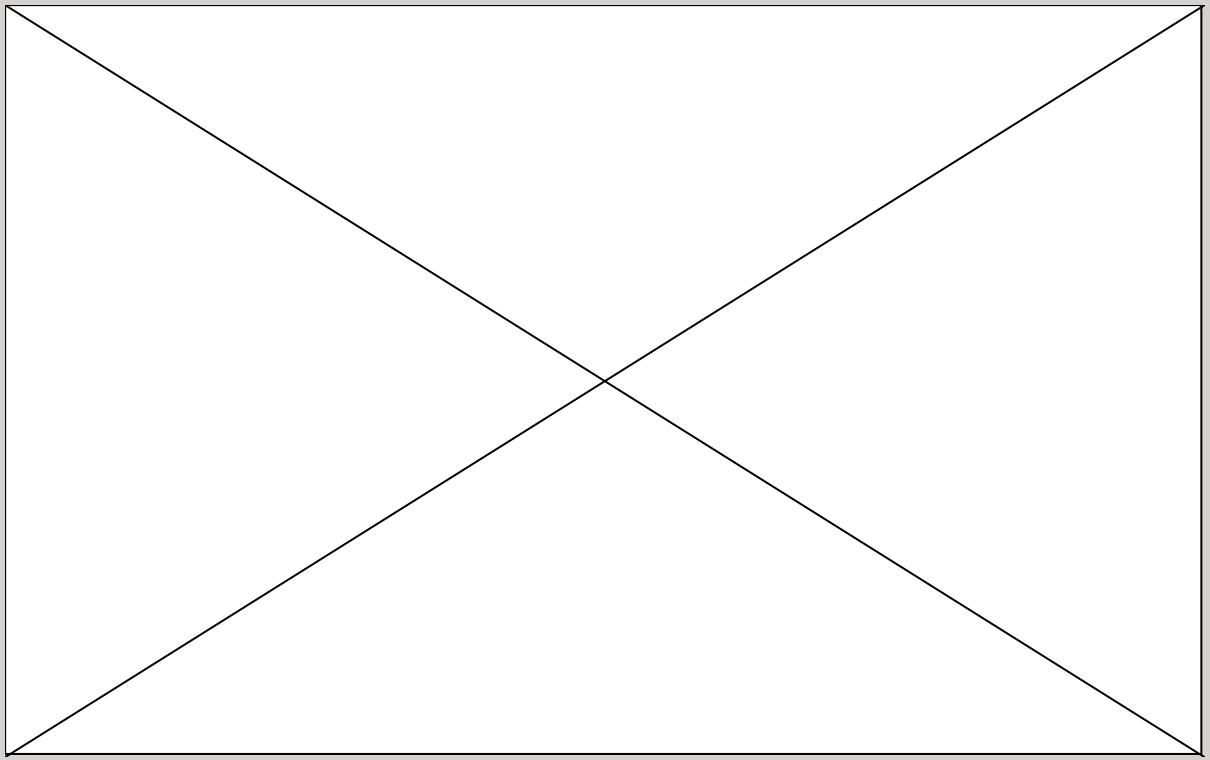


More Swarm Intelligence

- Many models also include collision avoidance
- To the right are plots from an experiment on exit clogging via human panic



UNC Chapel Hill's GAMMA Model



Mongol Crowd Simulation

- Visual