Computer Animation Algorithms and Techniques

Behavioral Animation: Crowds
Crowd Applications

For evaluation
Building evacuation, e.g. virtual fire drill
Architecture evaluation, e.g. signage

For training
Military scenarios, e.g. sniper training
Emergency response, e.g. disaster response

For entertainment: e.g., background crowds games
films, e.g., Titanic, Saving Private Ryan, Lord of the Rings
Qualities of crowd

Emergent behavior - similar to flocking, flocking system
Uniform – sameness of members
Quantity & density - average distance between members
Viewing distance – aggregate behavior, inspect individuals
Function – simple traversal, background activity, main actions

Individual processing – amount of computation per member
Physics – simulated reaction to environment
Intelligence - reasoning capability - agents
Uniformity, granularity

Background noise:
  Activity without intention

Statistical behavior:
  On average, intentional activity

Individuality:
  Believable activity at level of individual
Execution environment

Real-time v. Off-line computation

simple computations

avoid n-squared algorithms

size limited
Spatial organization

Cellular decomposition:
- Regular 2D grid
- Adjacency accessible
- Density limited
- Cells define obstructions

Continuous space:
- Step in any direction
- Need to decipher obstructions
- Perception needed
Perception Modeling

Vision

Memory

Knowledge of environment
Navigation

Fluid flow:
  density fields, potential functions

Particle systems:
  Individual navigation

Flocking systems:
  individual perception, navigation

Rule-based

Cognitive modeling

Cellular automata
Panic & Congestion handling

Personal space

Packing people during evacuation

Stairwell traversal

Exit awareness
Motion & Navigation

Path planning

Roadmaps

Passing on pathways

Potential fields

Forming & maintaining subgroups
Structure in crowds

Homogenous – no individuality

Subgroups
  Group by belief systems

A collection of Individuals – personality modeling
Penn Station

See animations
Other topics

Heterogeneous – pedestrians and cars

Data driven crowds – image processing

Comparison to real-world situations
Massive

http://www.massivesoftware.com/

Commercial de facto standard

See animation