Collision Models for Dense Crowds

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Overview
- Introduction
- Bounding Cylinder Hierarchy
- Collision Perception Experiment
- Results
- Conclusion

Dense Crowds

Collision Models
- Simplification
  - Single cylinder
  - Elliptical capsules (Dube et al, 2011)
- Smart data structures
  - AABB trees (van den Bergen, 1997)
  - K-dop hierarchies (Klosowski et al, 1998)
  - Sphere trees (Hubbard, 1996)
  - Oriented Bounding Box trees (Gottschalk et al, 1996)
  - BVH trees (Stüvel et al., 2013)
Hierarchical Collision Structures

For an object P, hierarchical structure H(P):

- Family of shapes (cylinder, box, sphere)
- Finite tree structure where each node v contains bounding volume B(v), representing sub-object P(v) in P
- A subdivision strategy that defines nodes in layer i+1 given nodes in layer i

Hierarchical Collision Structures

Given a node v, and its child nodes C(v) = {μ₁,...,μₖ}, and the interior of object X denoted as int(X):

1. \( P(v) = \bigcup_{\mu \in C(v)} P(\mu) \)
2. For all \( \mu, \mu' \in C(v), \mu \neq \mu' : \) \( \text{int}(P(\mu)) \cap \text{int}(P(\mu')) = \emptyset \)

Bounding Cylinder Hierarchy

Comparison

Comparison

Distance Before Collision
If the user can't perceive it, we don't have to simulate it!

Quite common in graphics (pixels vs vectors, simplified lighting models)

In animation, you can get away with a lot:
- Limbs stretching
- Blending between poses
- Physically incorrect motions

Still images containing two characters (F/M), randomly posed
Participants have to indicate whether the characters collide or not
Variables considered:
- Mesh–mesh distance $d$
- Camera distance
- Projected length of line segment identifying $d$
- Character silhouette overlap
- Character distance difference to the camera (absolute and relative)
Discussion & Conclusion

- Starting point for perceptive collision handling...
- ...but more investigation needed
- Still frames vs. animated characters
- Isolated characters vs. crowd
- Translating outcome of experiment into a perceptive collision handling system for crowds
  - Is BCH useful here?

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Projects:
- COMMIT (http://www.commit-nl.nl)
Release: September 2014
Develop four full-fledged games in JavaScript/HTML5
Many game programming concepts: the game loop, game states, physics, animation, AI, ...
Focus on mobile platforms
Interviews with Mark Overmars (Tingly Games, Game Maker) and Peter Vesterbacka (Rovio Entertainment – Angry Birds)