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Collision Models for Dense Crowds

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Overview

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

Dense Crowds

Dense Crowds



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

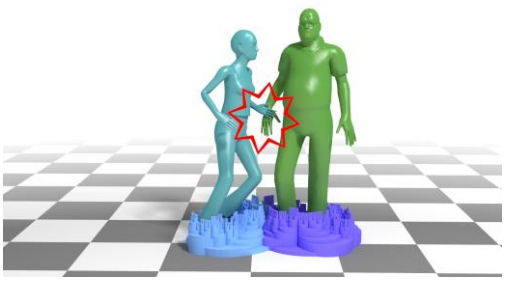
Hierarchical Collision Structures

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

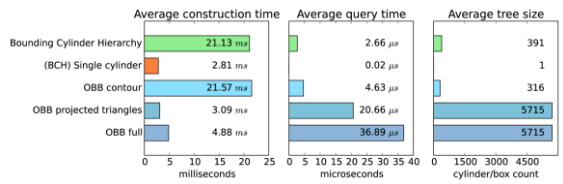
1. $P(\nu) = \bigcup_{\mu \in C(\nu)} P(\mu)$
2. For all $\mu, \mu' \in C(\nu),\ \mu \neq \mu' :\ int(P(\mu)) \cap int(P(\mu')) = \emptyset$

Bounding Cylinder Hierarchy

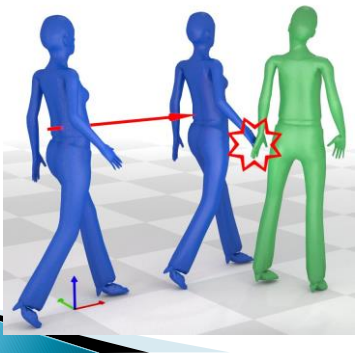
Comparison



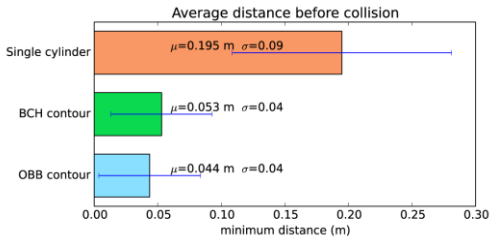
Comparison



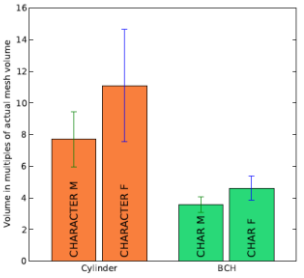
Distance Before Collision



Distance Before Collision



Occupied Volume



User Perception

- 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

Collision Perception Experiment

- 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)

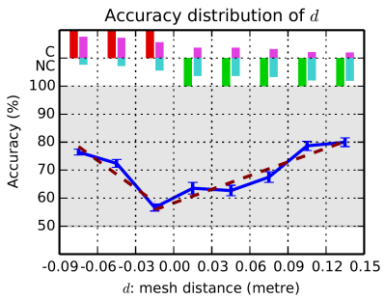
Do these characters collide?

Yes, they do!

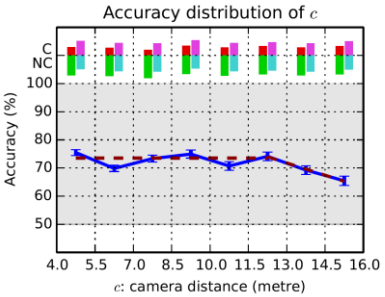
And what about these?

No collision!

Results



Results (2)



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?

Acknowledgements

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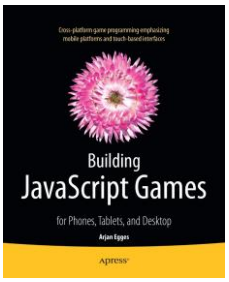
Projects:

- 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)