Collision Detection

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(윤성의)

Course URL:
http://jupiter.kaist.ac.kr/~sungeui/SGA/
Course Administration

- Make progresses on your chosen topic
  - Write down toward the mid-term report, whose deadline is Nov-6

- Presentation schedule
Proximity Queries

● **Collision detection**
  - Checks whether there is collision between objects
  - Reports colliding primitives if any

● **Minimum separation distance**
  - Compute a minimum distance between two objects and report primitives realizing the distance
Collision Detection

- **Main component of:**
  - Dynamic simulation for game & movies
  - Navigation and path planning
  - Virtual prototyping
Time Complexity

- Naïve method between two objects
  - $O(n \times m)$, where $n$ and $m$ are # of triangles of two objects
  - Can be very slow even for small models

- Can we do better?
  - Employ culling techniques
Hierarchical Representations

- **Bounding volumes**
  - A proxy containing primitives
  - Should be tight and easy to check for collision
  - Provide culling

- **Recursively represent models**
  - Provide hierarchical culling
  - Object partitioning hierarchies or space partitioning hierarchies
Object vs. Space Partitioning Hierarchies

**OPH:**
- Object centric
- Spatial redundancy
- e.g., BVHs

**SPH:**
- Space centric
- Object redundancy
- e.g., kd-trees

Modified from Prof. M. C. Lin’s slides
Object vs. Space Partitioning Hierarchies

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Bounding Volume Hierarchies

- Each node has bounding volumes
  - Leaf node has $k$ primitives; typically, $k$ is 1

BVH
Trade-off in Choosing BV’s

- Sphere
- AABB
- OBB
- 6-dop
- Convex Hull

Increasing complexity & tightness of fit:

Decreasing cost of overlap tests + BV update

Excerpted from Prof. M. C. Lin’s slides
BVH-Based Collision Detection

Bounding volume test tree (BVTT)

Refine one node
Hierarchy Construction

- Top-down vs. bottom-up approach

  - Top-down methods
    - Recursively partition primitives into two subsets

  - Bottom-up methods
    - Merges nearby primitives into BV nodes
Continuous Collision Detection

- Discrete checking
  - Can miss collision if time step is large

- Continuous checking
  - Always identify collisions
  - Expensive