Accelerating Ray Tracing

Bounding Volumes

Simple volume description guaranteed to contain a more complex volume description
Test ray against more complex primitive only if it intersects bounding volume
Increases time for hits, but reduces time when ray misses bounding volume
Provide bounds on interval of intersection

Bounding Volume Hierarchies

Cluster bounding volumes hierarchically
Only intersect ray with child volume if it intersects parent
Reduces number of ray-volume and ray-object intersection tests
Bounding Volume Tree

Computing Hierarchies
- Top-down
- Bottom-up
- Minimize volume/surface area
- Computing “good” hierarchies is difficult

Space Partitioning
- Break model space into chunks
- Pre-compute which objects overlap each chunk
- Trace rays through chunks
- Only intersect rays with objects stored in current chunk
- Typically only allow each ray-object intersection once (not in multiple chunks)

Types of Space Partitions
- Uniform
- Octree
- K-d tree
- BSP Tree

Tracing through a Space Partition
- Incrementally
  - trace along ray, walk from partition to partition
  - difficult except for uniform partition
  - other partitions may require augmented data structures
- Top-down
  - intersect ray with each of node’s children
  - traverse children it intersects

Frustum Culling
- Cull all bounding volume nodes that lies outside current viewing frustum
- Probably not necessary if using space partition
Frameless Rendering

Double buffering - wait for all pixels to display image
  • Slowly displays old images

Frameless rendering - display all pixels immediately
  • Quickly displays partially-updated images

Applicable to interactive applications requiring low latency and high performance

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Frameless Rendering Example

All pixels updated at 5 Hz
33% pixels updated at 15 Hz


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Interactive Ray Tracing

Experiments run on high-end parallel machine
  • Scales to hundreds of processors on SGI Origin 2000
  • Scalability limited only by load balancing and synchronization

Can employ frameless rendering

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Interactive Ray Tracing Video


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