Accelerated Ray Tracing

- Fast intersection computation
- Spatial Subdivision
- Higher dimensional subdivision
- Memory coherency
Fast intersection computation

- Optimized code
- Spheres
- Bounding boxes
  - Axis aligned
  - Oriented (transform rays - Rubin & Whitted)
- Slabs forming convex hulls
- Hierarchies
  - Higher order objects
  - Object clusters
Spatial Subdivision

- Uniform - Fujimoto
- Multilevel - Jevans
- Hierarchical - Octree (Quadtree)
- BSP tree
- Dealing with multiple hits
Higher Dimensional Spaces

• Space-time for canned animations
  – $S(x,y,z,t)$, coherence wins
• $R^3 \times S^2$ - 5D ray classification
  – Light buffer (scan conversion on faces)
  – Ray classification with limited reach
  – lazy evaluation
• Ray bundling - safety zones
Parallel implementations

• SIMD/Vector machines
  – Karl Sims - Connection Machine
  – Nelson Max - Cray

• MIMD
  – Distribute rays - scene data replication
  – Distribute data - sending rays over interconnect
Memory coherency

• Handling huge scenes - too big for memory
  – Caching in modern architectures
  – Cost of random accesses - cache misses

• Coherent storage in voxels
  – nearby rays hit same objects

• Reordering computation to bundle rays
  – Massive SIMD machine issues
  – Caching performance, from disk
Toward Real-Time Ray Tracing

- Tailored memory allocation
  - a priori knowledge of chunk size, etc.
  - Geometry Cache, Texture Cache
- In-place geometry expansion
  - Higher order surfaces, displacement maps
- Hardware acceleration
  - ART
  - Embedded DRAM
Upcoming lectures

- 4/27 Color - Maureen Stone
- 4/29 Radiosity - Don Greenberg
- 5/4 More Radiosity - Greenberg
References

• Chapter 6 in the Glassner text
More References


