WebGL-Enabled Remote Visualization of Smoothed Particle Hydrodynamics Simulations

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Motivation

• Create a portable remote visualization application for SPH
• Easily share data with collaborators
• Immediate low resolution viewing while higher resolutions load
Smoothed Particle Hydrodynamics

SPH weighting kernel

\[ W(\| \mathbf{P} - \mathbf{P}_i \|, h_i) \]
Data Sets

Mixing simulation  2,097,152 particles

Sphere collision simulation  1,048,576 particles

Two sphere drop simulation  2,097,152 particles
Octree Compaction

- Create octree from particle data on the server
- Use a variance and gradient metric to compact the tree
Octree Compaction Results

- Amount of compaction varies per data set and per time step
Client-side System Architecture

- Rendering done with WebGL in main thread
- Requests for new data sent to a worker thread using WebWorkers
- Processing the raw octree data into a texture occurs in the worker thread
Neighbor Linking

- Compute links to neighbors in all 6 directions
- Can link to nodes at different levels
- Used later for octree texture representation
Octree Texture Representation

- Separate textures for octree nodes and data
- Parent node stores address of where child block starts
- Data texture stores leaf grids
  - 2x2x2 grid of data surrounded by ghost cells
  - Use hardware linear interpolation
Comparison of Octree and Uniform Grid Texture Representations

- Uniform grid rendering is generally faster
- For larger data sets with sparse octrees, direct octree rendering may scale better
- Larger leaf grids may also improve performance for direct octree rendering
Level of Detail

- Stream octree in a breadth first manner
- Lower levels of detail give general shape of the data
Implementation

Current time step: 0 of 312
FPS: 28.97
1 million particle sphere collision

Load previous timestep  Load next timestep  200  Go to timestep

set max level  Reload Shaders  Switch to octree

Alpha modifier
Select peak values for transfer function

48.22%  51.98%
Conclusion

• Remote visualization for SPH simulations
• View low resolution while high resolution loads
• Browser-based application for portability and flexibility
Thanks for listening!

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