Octreemizer: A Hierarchical Approach for Interactive Roaming Through Very Large Volumes

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Geo-Scientific Exploration in Virtual Environments



□ Interactive frame rates

□ Massive amounts of data

- Multi gigabyte seismic volumes
- High resolution interpreted data
- Multi-attribute well log data
- Reservoir data
- Well editingDistributed work

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Reflection Seismic





Large Volumes: Overview and Roaming



Octreemizer



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Multi-Resolution Representation





Octreemizer™

Hierarchical bricking

- Octree
- Adaptive display

Constraints

- Interactive frame rates
- Bricks fit in texture & main memory
- 3D Texture reload limit per frame

Paging

- From hard disk to main memory
- From main memory to texture memory

□ Sampling geometry

- Arbitrary polygonal meshes





3D-Texture Paging Algorithm







3D-Texture Paging Algorithm





Hierarchical Predictive Volume Paging - Geometry Extrapolation



□ Combination of current and predicted wish list



Hierarchical Predictive Volume Paging – Moving Hull



- □ Neighbors of most recent used bricks loaded first
- □ Bricks loaded asynchronously from hard disk
- Octree file format optimized for speed
 - Single file, precalculated file offsets
 - Child bricks stored sequentially
- □ Start up time reduced to minimum



Performance measurements

Octreemizer

Data set size	120 MB	2.1GB	16GB
Texture memory size	10 MB	64MB	64MB
Main memory cache	120 MB	400MB	400MB
Time per frame static	7ms	15ms	14ms
Time per frame moving	48ms	45ms	46ms

□ Performance for static volume lens dominated by texture fill rate

□ Performance for moving volume lens dominated by texture reload and geometry insertion

□ No cache misses produced by loading bricks from hard disk



Influence of Prediction Strategy

	min	max	average	dev
slow / no P	3.6	5.0	4.85	0.18
slow / P	4.6	5.0	4.99	0.017
fast / no P	3.2	4.5	4.18	0.15
fast / P	4.1	4.4	4.22	0.05

- □ Less frames without texture reload
- Average brick depth higher or equal
- □ Standard deviation much smaller
- □ Better visual quality



3D Texture Fill Rates





3D Texture Fill Rates



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IMI

3D Texture Download





Current and Future Work

- □ 3D filters: contrast enhancement, erasing, iso-surfaces, gradient shading, modeling, ...
- □ Volume shading, advanced lookup table applications
- □ 4D data, multi-attribute volumes, adaptive representation of FEM data



