Painterly Effects

- Martell Ad - Siggraph ‘95 Tape
- Barbara Meier - Siggraph ‘96 (tape)
  - Strokes as 3D particle sets
  - Sorted, rendered with painters algorithm
  - Reference images or additional data used to determine shading, etc.
  - Diagram from paper
- Litwinowicz - ‘97
- Watercolor-Siggraph ‘97
  - Siggraph ‘97 tape

Voxels

- Medical imaging - CAT, MRI, PET, etc.
  - Visible human - physically sliced
- Herman and Liu ‘79 - first use of “voxels”?
- Meagher ‘82 - Octrees
- Octree Demo - http://www.Octree.com
- Displaying voxels
  - Ignore perspective
  - Write to screen in convenient order, or
  - Trace rays into volume
  - How do voxels become pixels?

Shading for Voxels?

- Density images
  - couples with medical training
  - sum, blend, ray-trace
- Density thresholding to define surfaces
  - inore voxels below threshold
  - “classification” with multiple thresholds (fat, bone, etc.)
- Intensity fades with depth
- Visible voxel faces (6 colors)
- Local gradient from nearby voxels - average
- Explicit colors a la texture

Surfaces from Voxels

- Better images of surfaces desired
- Triangulate over thresholded voxels
- Connecting contours - ambiguities arise
- Marching Cubes
  - using binary (in-out) values at voxel vertices
  - symmetries limit to 14 intersection cases
  - triangulate and get normals (via lookup?)
  - save edges for re-use in next row, plane
  - extend to linear interpolation, surface refinement

Rendering Volumes from Voxels

- Pixel per voxel
  - OK for medical imaging, etc.
- “Splats”
  - For varying voxel/sample sizes
  - Useful in IBR as well
  - Laur and Hanrahan ‘91, volume hierarchy
    - Volume mip-map
  - Approximation by accelerated polygons

Shear-Warp Rendering

- Resample over adjacent pixels to shear each plane
- Shearing aligns pixels in depth
- Composite pixels to intermediate image
- Warp to final image (texture map hardware)
- Lacroute and Levoy ‘94
  - Run-length encoding on voxel scans for parallel projection
  - Minification resampling for perspective

Commercial hardware

- Mitsubishi VolumePro
  - Breadth-first ray casting in parallel
  - Can be inexpensive with high enough volume
- Medical imaging, etc. vs. mass-market
  - What’s needed for entertainment?

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- [Osborne97] Randy Osborne, Hanspeter Pfister, et al, "EM-Cube: An Architecture for Low-Cost Real-Time Volume Rendering", 1997 Siggraph/Eurographics Workshop on Graphics Hardware, August 1997, pp. 131-138.