Accelerating Volume Rendering

Ray casting
- Alpha-cutoff
- Space leaping

Splatting
- Hierarchical splatting
- Texture splats

Parallel algorithms
- Screen-space subdivision
- Object-space subdivision

3D texture mapping
- Transparent textures
- Shaded isosurfaces
Texture Splats

Uses texture hardware to apply contribution of each voxel to pixels

Precompute splat kernel texture

For each voxel plane (front-to-back)

For each voxel

Translate textured polygon

Set rgba according to voxel

Render textured polygon
3D Texture Map Approach

Load volume data into 3D texture hardware

Generate set of slice polygons parallel to viewing plane

Render slices with 3D texture coordinates in front-to-back order
Transparent Textures Illustration

Clipping Volumes

Useful for getting clear view of interior structures

More general than just clipping planes

Possible using pixel-operations on each slice
Clipping Box Examples

(a) Box clipping performed with the stencil buffer.
(b) Inverse box clipping of the brain.

Clipping with the Stencil Buffer

Allow any closed, polygonal clip volume
Slice needs to be culled to pixels inside clip volume
Align clipping plane (near plane) with slice
Render clip volume into z- and stencil-buffers
  • Back-facing polygons set stencil buffer
  • Front-facing polygons clear stencil buffer
Render slice with stencil-buffer test enabled
On the plane, pixels where we see the interior of the clip volume should leave the stencil buffer set, so those pixels of the volume are rendered.

Direct Iso-surface Rendering

Advantages

• Avoids generation of polygonal representation
• Allows interactive setting of threshold value

Store volume values in alpha component

Enable alpha test to only render slice pixels with alpha $\geq$ threshold

Also enable z test so only first such value is rendered
Iso-surface Shading

- Store gradient + material value in another 3D rgba texture
- Render iso-surface from gradient texture
- Apply directional light using color matrix multiplication (copy buffer onto itself)
- Build normal transformation into the same matrix
Iso-surface Examples