ECS 277 – Lecture 2

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What am I going to talk about?

- Quick Recap

- I am going to do ECS 177 in two days

- Volume Rendering
  - Levoy’s Algorithm (and variations)
Recap

- There are a variety of types of meshes
  - Different base elements
  - Different Connectivity
  - Regular, Unstructured, Zoo, etc.
  - Adaptive Meshes

- Your visualization algorithm frequently depends on the mesh type.

- One of the basic algorithms of Visualization is isosurfacing.
  - Marching cubes is the fundamental paper
Interpolation

- We have a discrete set of data
  - Data at only a few points

- We need to “approximate” data at any point in “space”
  - Common method – Interpolate

- Typical Interpolation Methods
  - Linear
  - Cubic
Bilinear Interpolation
Trilinear Interpolation
Higher-Degree Interpolation

- Bicubic Interpolation

- Tricubic Interpolation
Barycentric Interpolation

- Triangles

- Tetrahedra
Volume Rendering
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Volume Rendering
From Ray Tracing Principles
Levoy’s Algorithm
Levoy’s Compositing

☐ Back-to-front, using the over operator

\[ C_{out} = C_{in} \cdot (1 - \alpha) + C \cdot \alpha \]

\[ \alpha_{out} = \alpha_{in} \cdot (1 - \alpha) + \alpha \]
Transfer (Opacity) Function
Determine Color using Phong Model
Volume Rendering
The Message

☐ Solved Problem

☐ Difficulty is determining the transfer function
Tex. Mapping for Volume Rendering

- Consider ray casting ...

- (top view)
Texture based volume rendering

- Render every xz slice in the volume as a texture-mapped polygon
- The proxy polygon will sample the volume data
- The polygons are blended from back to front

Use pProxy geometry for sampling
Texture based volume rendering

Polygon Slices  →  2D Textures  →  Final Image
Changing Viewing Direction

- What if we change the viewing position?

- That is okay, we just change the eye position (or rotate the polygons and re-render),

- Until ...
Possible Texture Orientations
Message

☐ Solved Problem

☐ GPU Acceleration is “easy”

☐ Difficulty is the transfer function, color function
  ■ This is where the interesting research remains
Visualization Software

Volume rendering methods are available in “every” visualization software package.