Challenges of Volume Rendering in a Virtual Reality Environment

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Motivation
Some history

New stone age (10'000 B.C.)  Middle age  Today
Laser!
Why still spend hours/days to segment data sets?
Solution? Volume Rendering+

• Well known technique
• Intuitive
• No pre’segmentation required
Volume Rendering in VR! Feasible?

• 3D depth perception
• More intuitive than on screen
• Faster

VR requires 180fps
Why Volume Rendering

Pros
• High quality images
• No manual input apart from the selection of transferfunction

Cons
• Computationally complex
• In VR challenging
• Difficult scene renderer to embed polygonal objects
Computational Complexity

1 Million Triangles
- Is considered a big mesh

1 Million Voxels
- Is considered small (100x100x100)
- Typical size 512x512x500
Basic Forward Ray-Casting

Eye → Image Plane

Volume Data Set

Transfer Function (color, alpha, emission)
Transferfunction

- Transparency
- Color
- Emissivity
Transferfunction (2)
Difficult Cases

- Fluffy objects
- Lots of air

- Early stopping
- Distance transform
Shadows
Fusion with Mesh Objects
Fusion with Mesh Objects (2)
Sample Movie
Sample Movie (2): Neurosurgery
Sample Movie: Collaborative Viewing
Conclusion

• Volume Rendering for VR is possible
• It has disruptive potential
• Adds a new dimension to data visualisation
• Mainly thanks to
  • Modern GPU hardware
  • Modern VR glasses
  • Clever programming

https://diffuse.ch