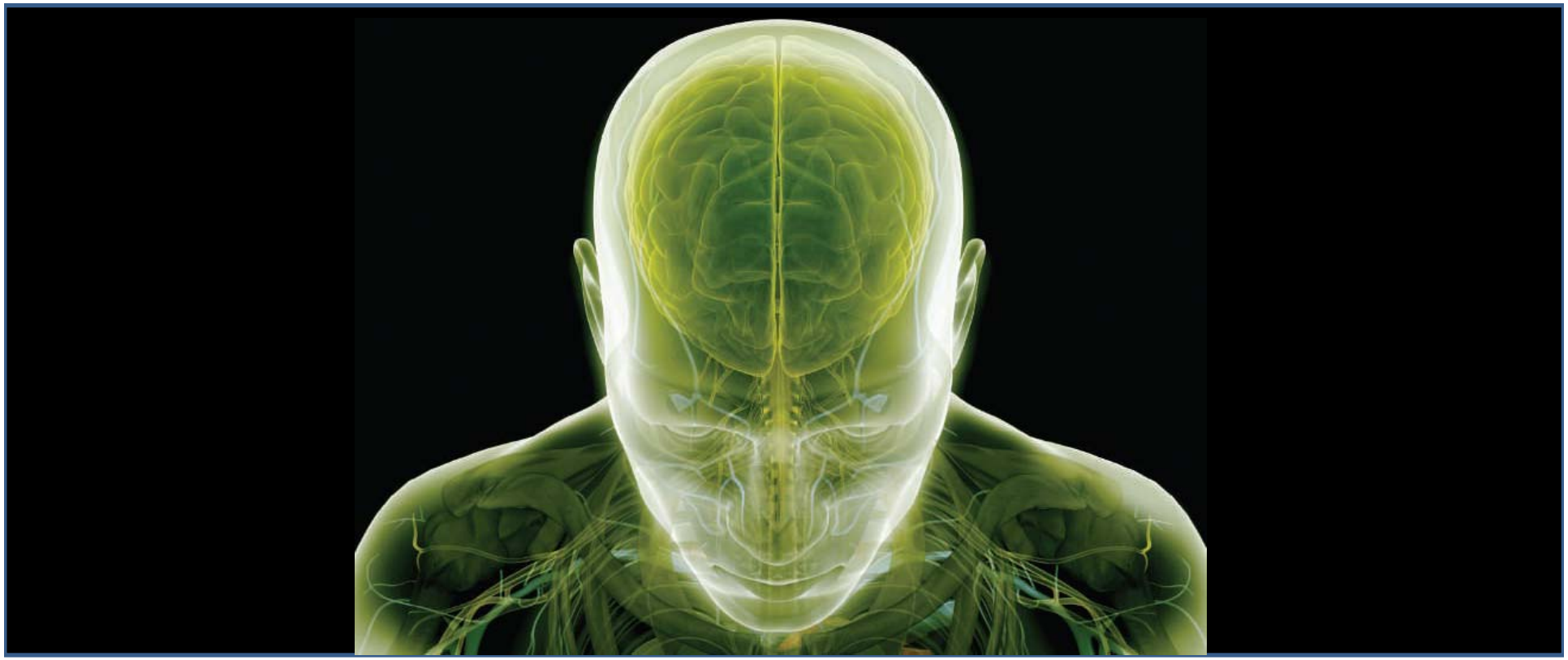
TECHNICAL UNIVERSITY
OF CLUJ-NAPOCA

3D Visualization Algorithms Using VTK



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Objective

- Understand and implement the techniques used for medical image visualization (especially in neuroscience domain)

Contents

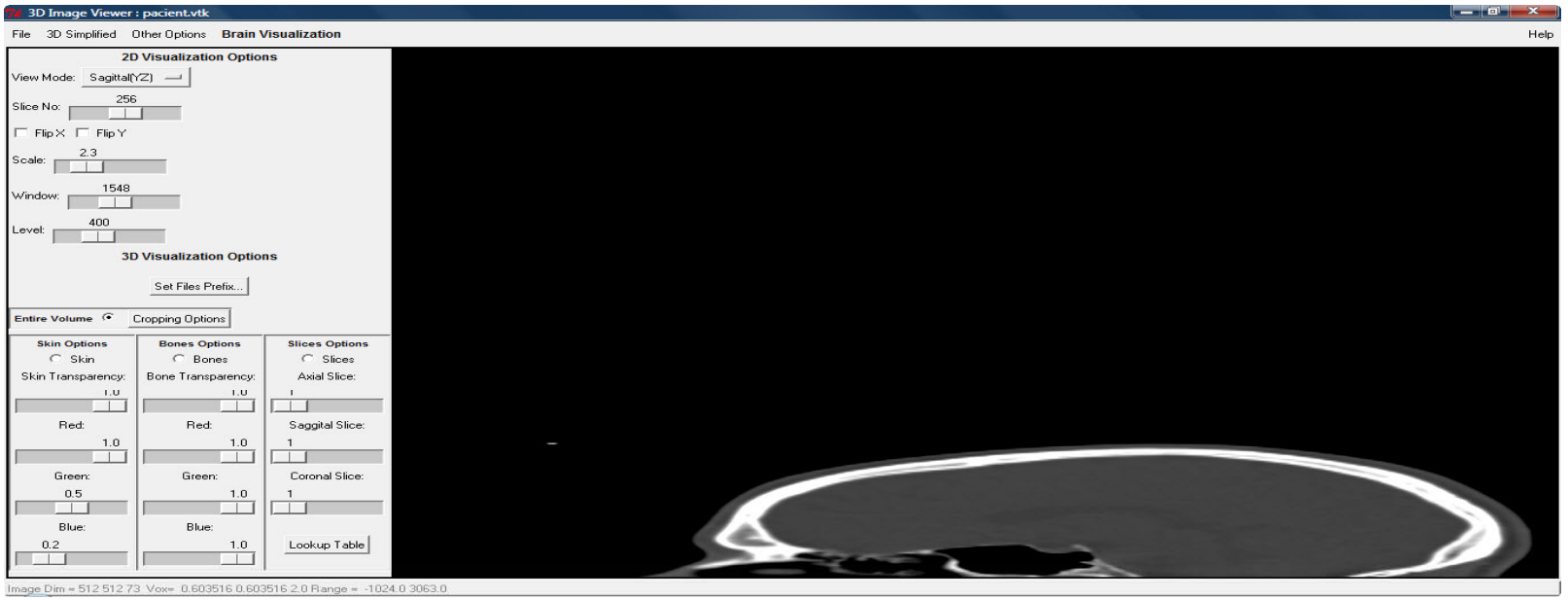
- Techniques and Tools
- 2D Visualization Methods
- 3D Visualization Methods
- Conclusions

Techniques and Tools

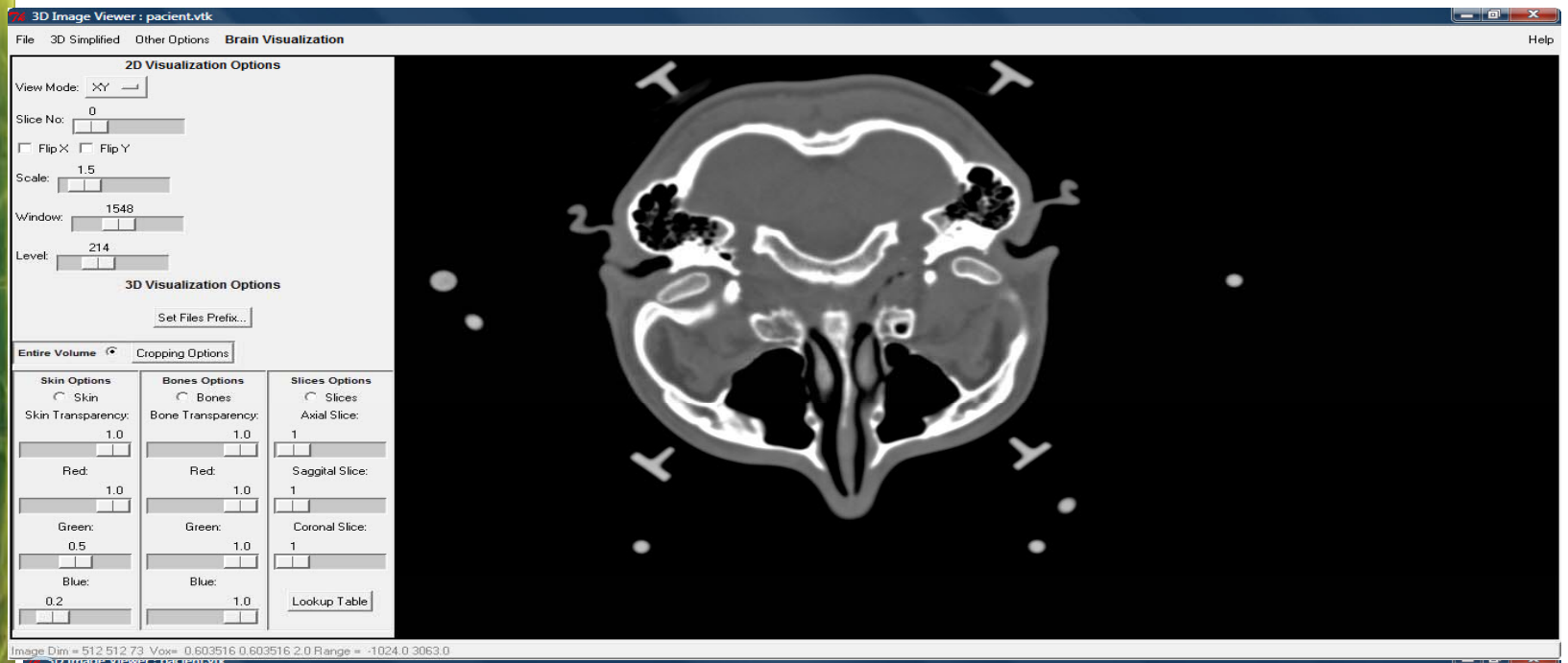
- **Common acquisition methods:**
  - Computed Tomography (CT)
  - Magnetic Resonance Imaging (MRI)
- **Medical format: DICOM**
- **Why it is not good to use DICOM in 3D visualization?**
- **Implementation:** *VTK
  *Tcl /Tk scripting language

*VTK – Visualization Toolkit
*Tcl/Tk – Tool Command Language

2D Visualization



Window and Level Adjustments



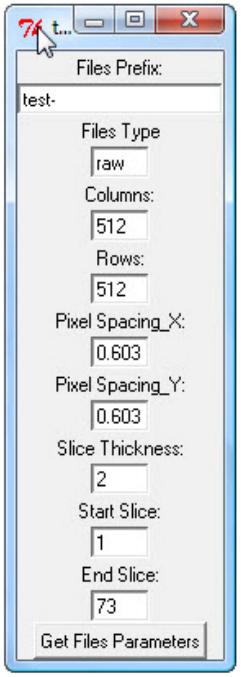
3D Medical Visualization Algorithms

- **Main methods of volume rendering in medical visualization:**
  - **Indirect volume rendering**
    - **Plane-based volume rendering (“the cine mode”)**
    - **Surface-based volume rendering**
  - **Direct volume rendering**
    - **Ray Casting Algorithm**
    - **Shear Warp**
    - **Texture-Mapping**

Converting DICOM to RAW

- **Transform DICOM format into RAW format**

- **Reading the files interface:**

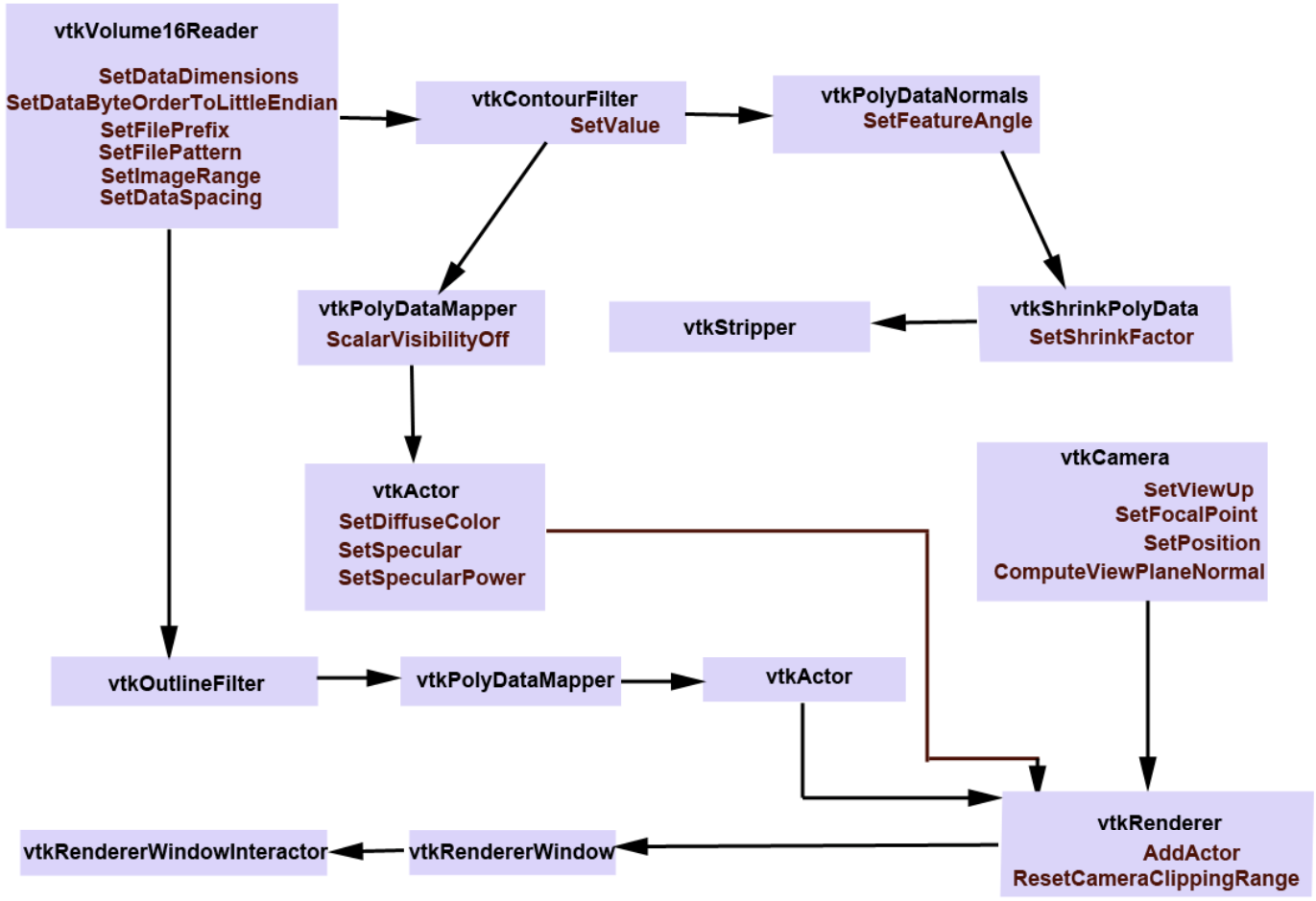


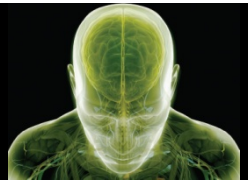
Rows (0028,0010) 1 US [512]
Columns (0028,0011) 1 US [512]
Pixel Spacing (0028,0030) 2 DS [0.603515625\0.603515625]
Slice Thickness (0018,0050) 1 DS [2]

(part of the header file)

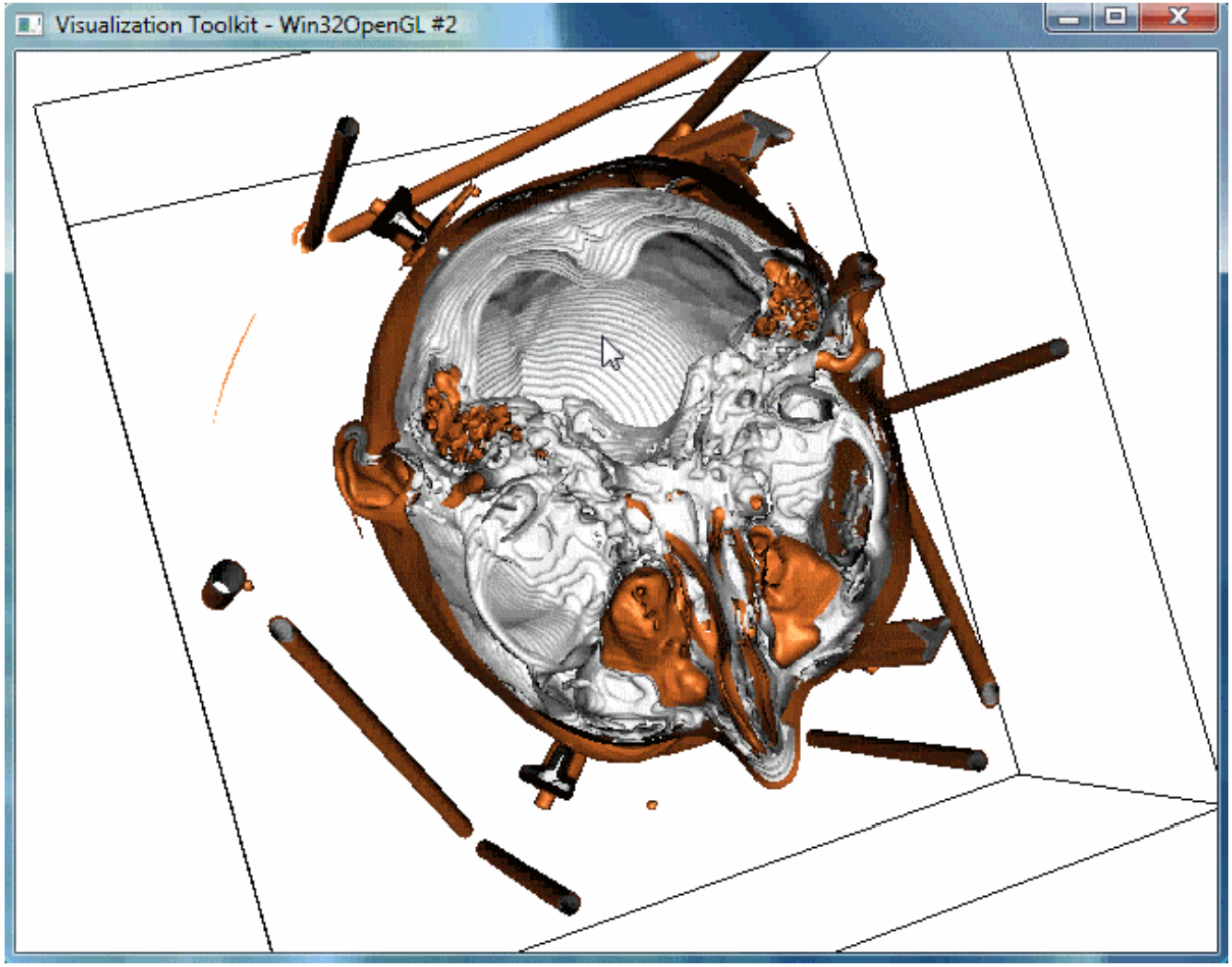
Isosurface Extraction

- **VTK Classes used for Isosurface Extraction:**

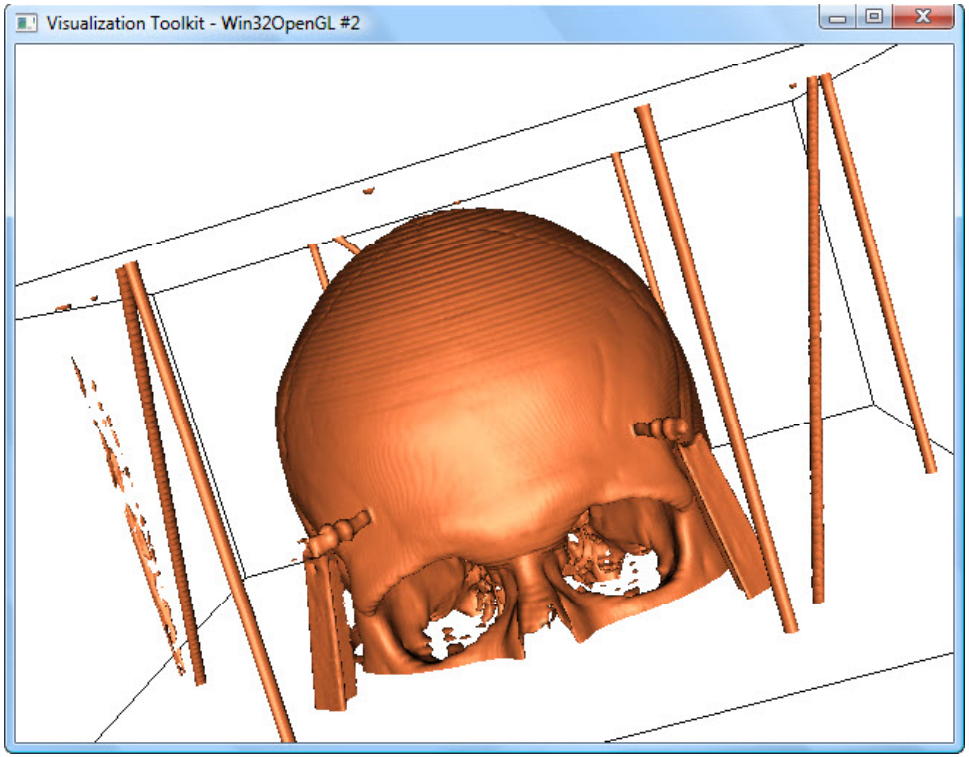


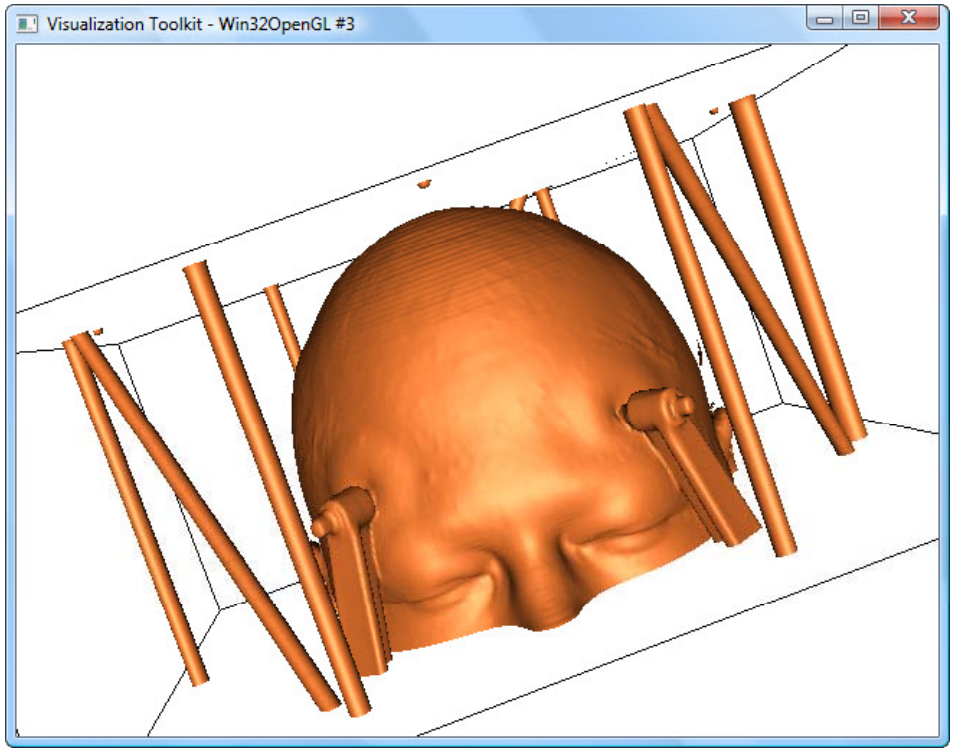


Bones and Skin Extraction

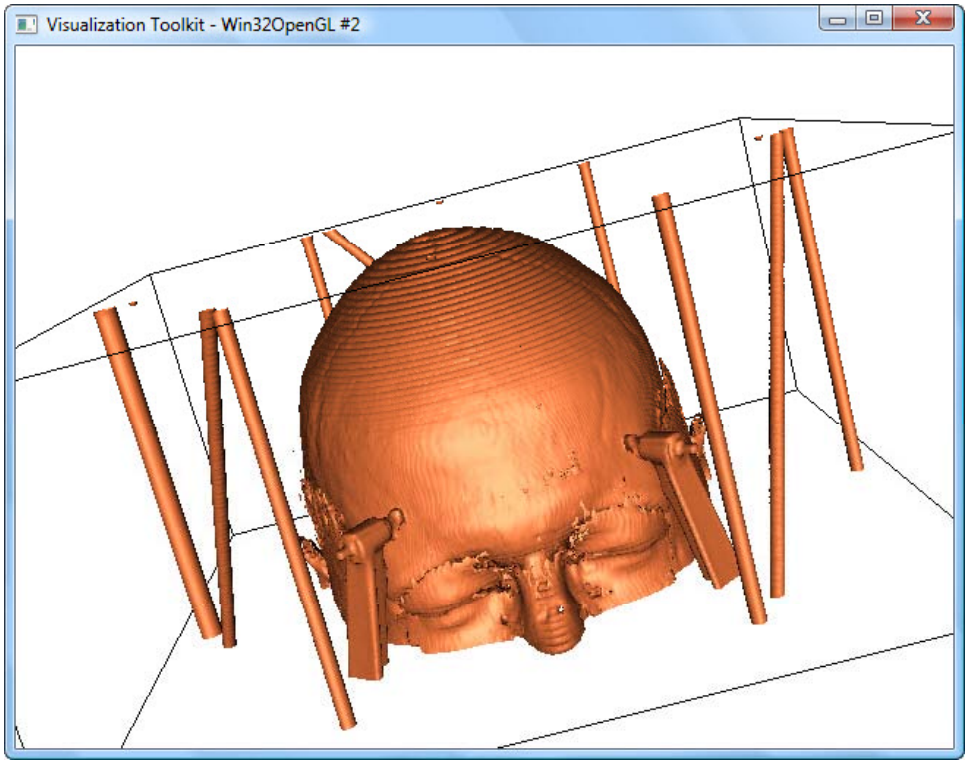


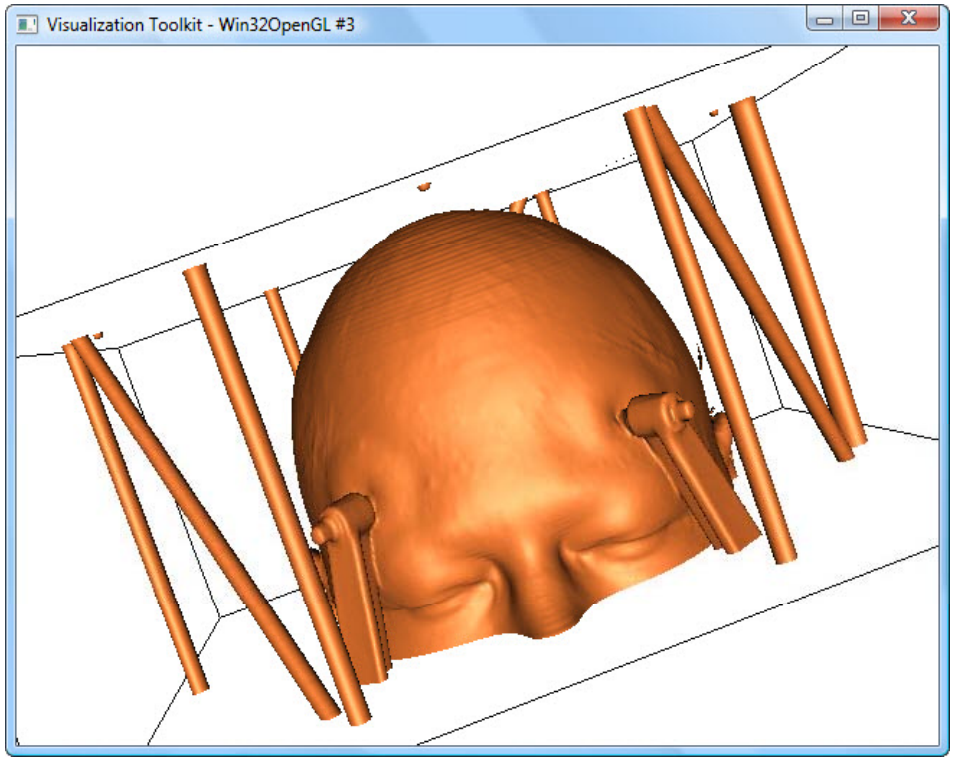
Isosurface Extraction: Skin Extraction
DICOM (isovalue = 500) versus RAW (isovalue=500)



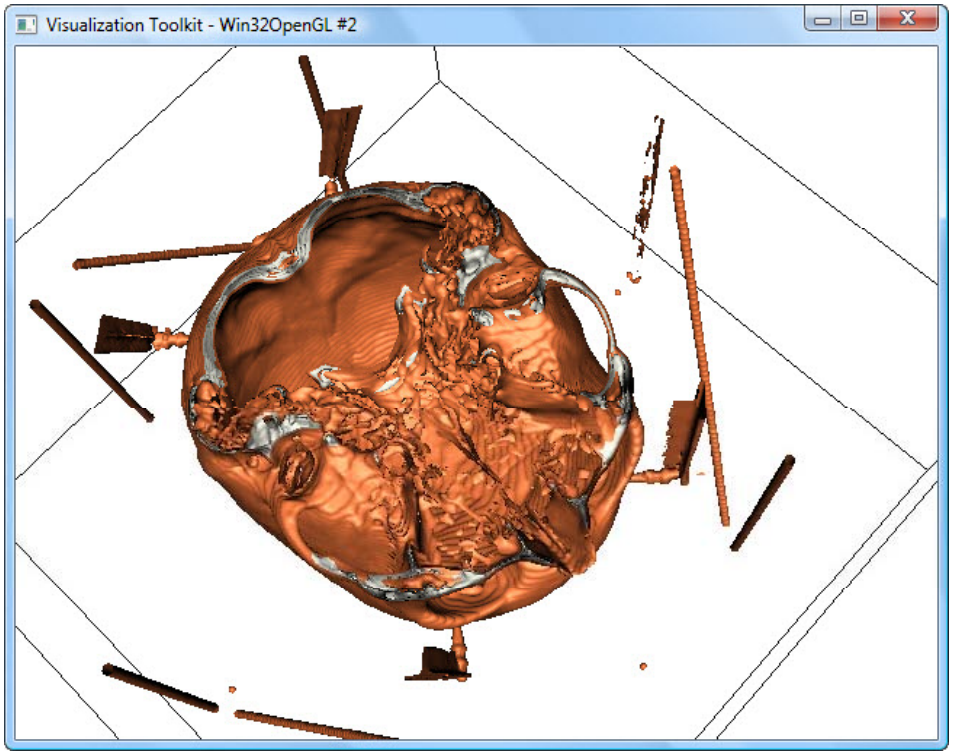


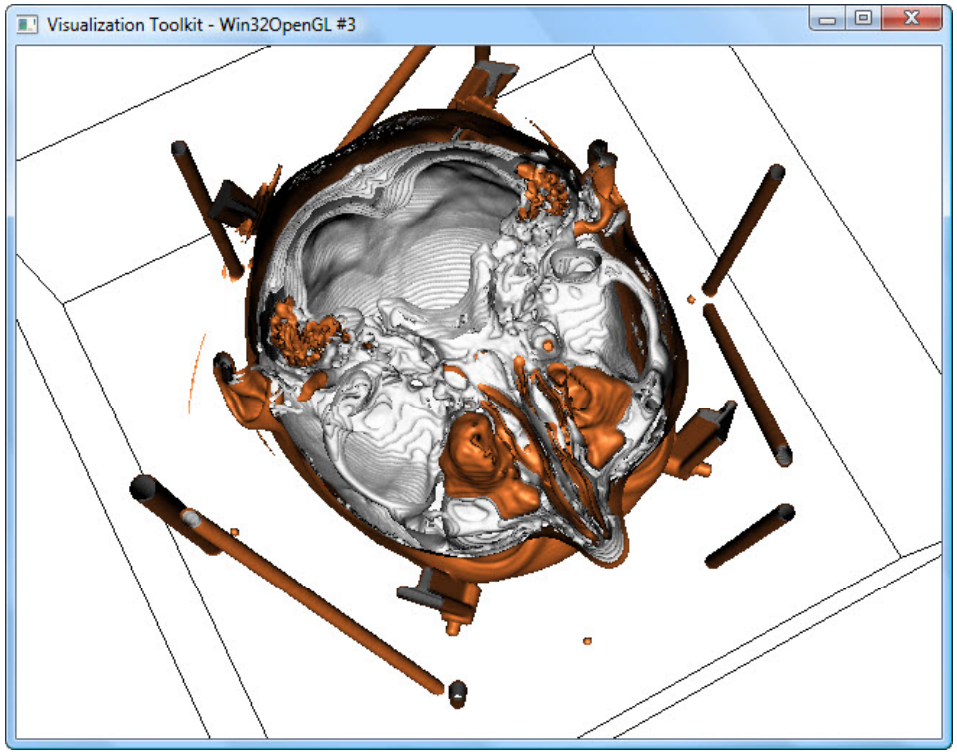
Isosurface Extraction: Skin Extraction
DICOM (isovalue = 100) versus RAW (isovalue=500)

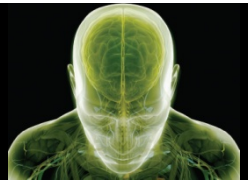




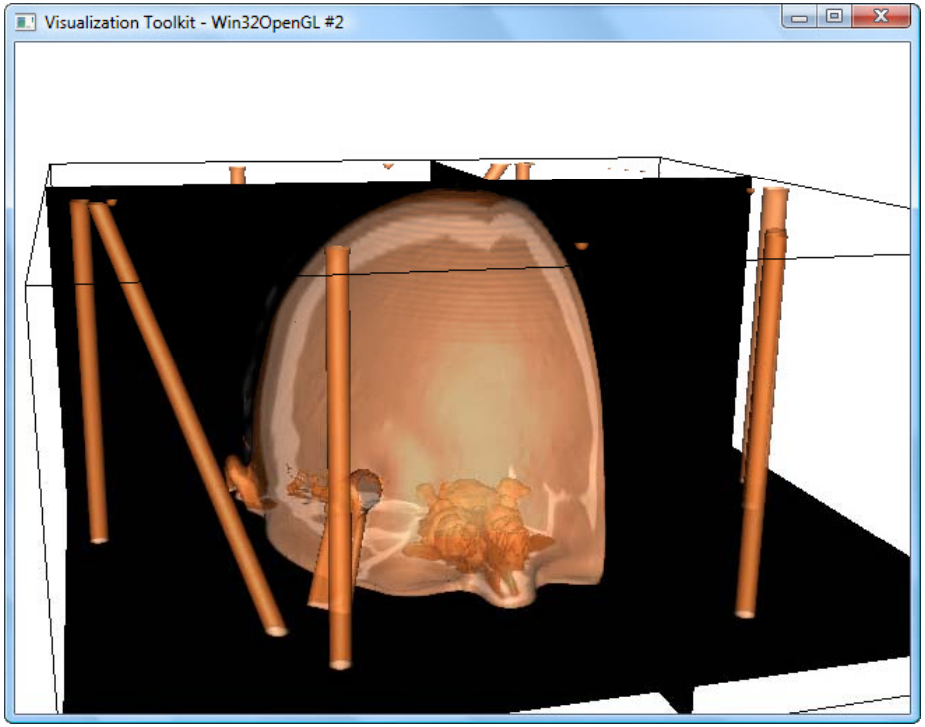
Isosurface Extraction: Bones Extraction
DICOM (isovalue = 1250) versus RAW (isovalue=1250)

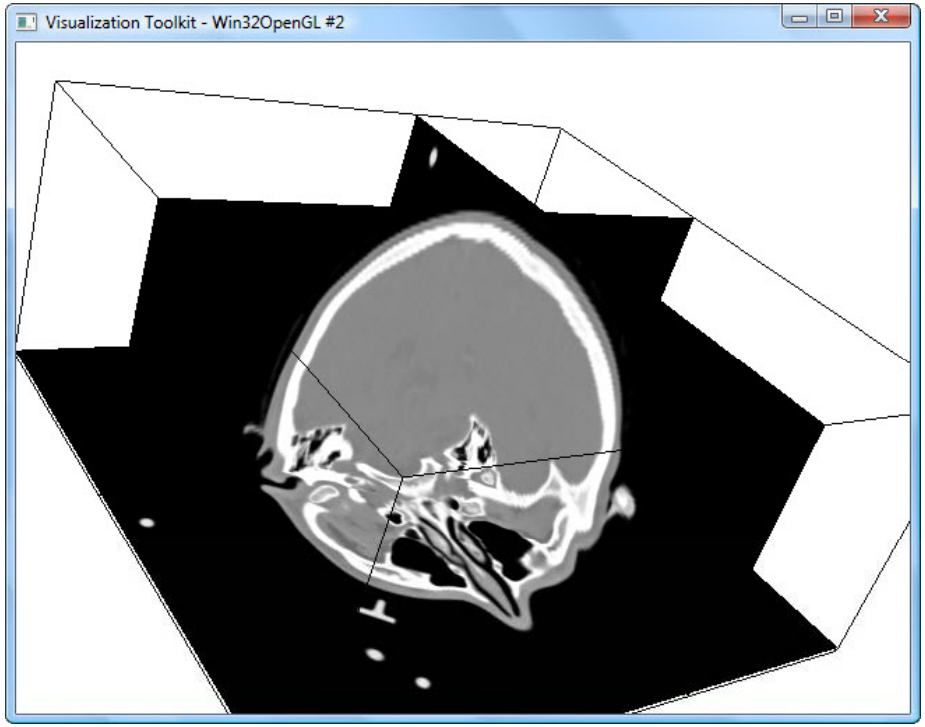






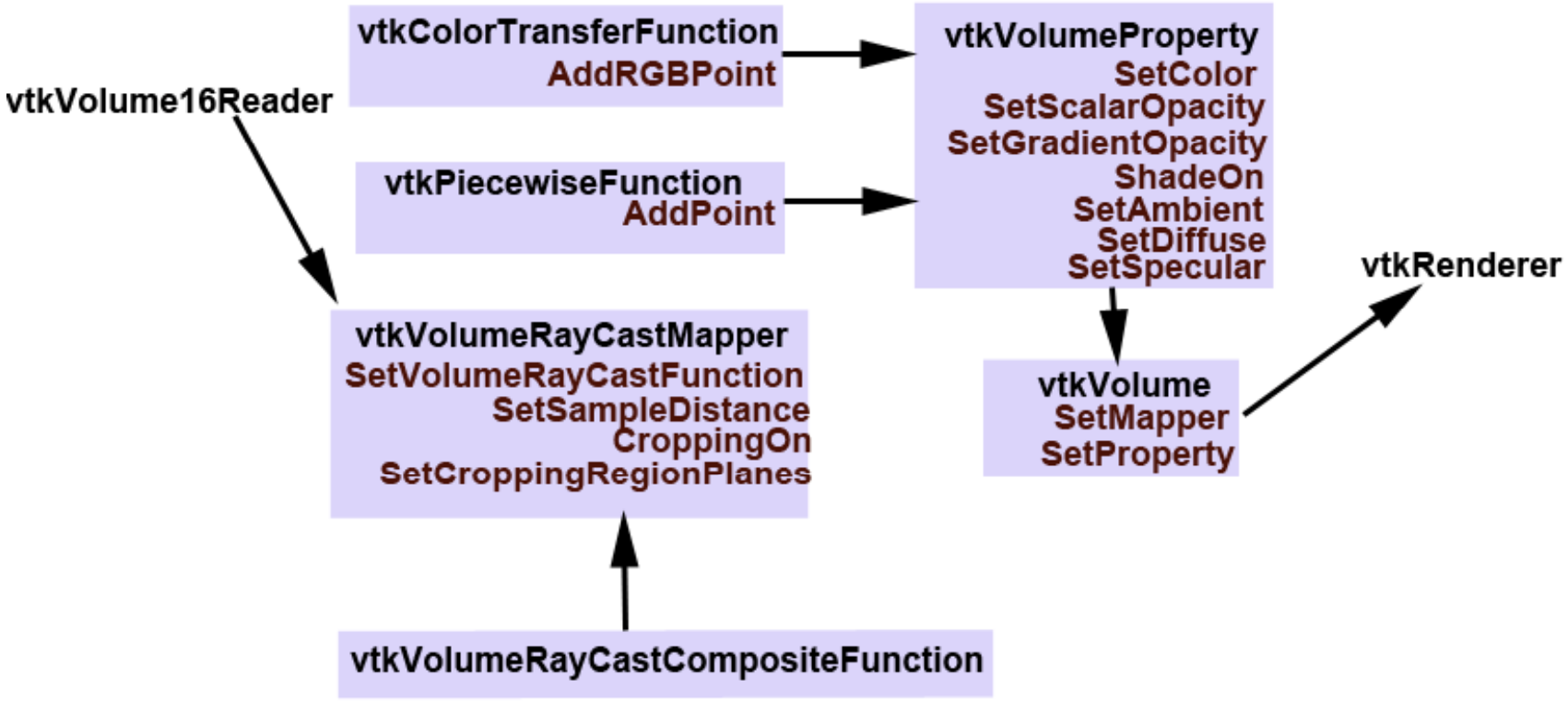
Volume Visualization Including the Orthogonal Planes

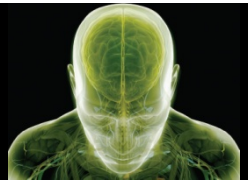




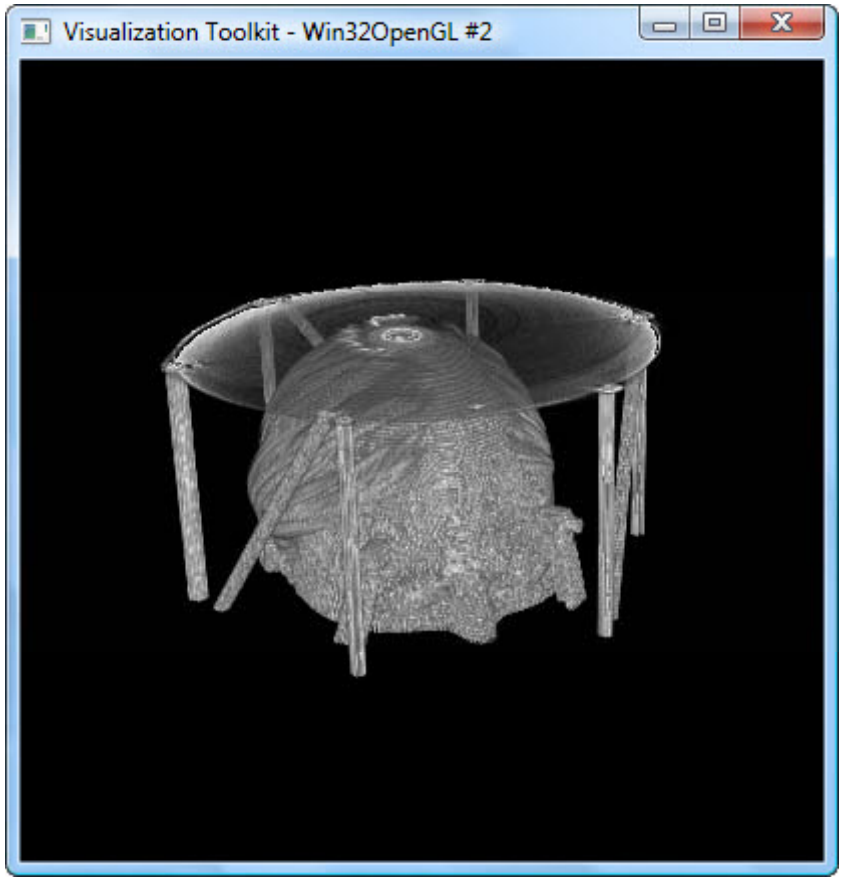
Direct Volume Visualization

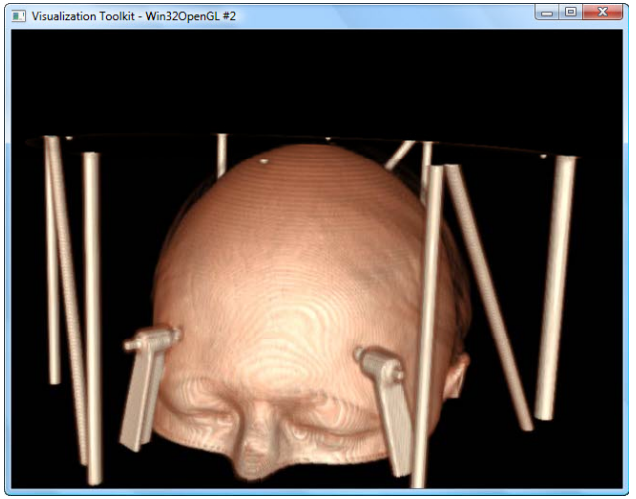
- **VTK Classes used for Direct Volume Visualization:**

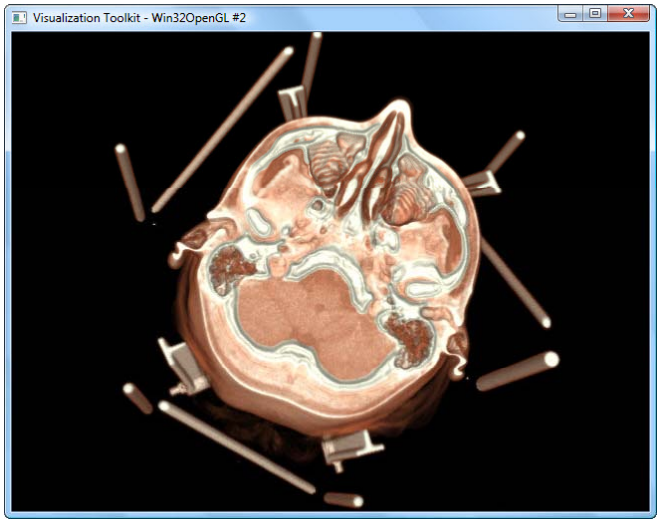


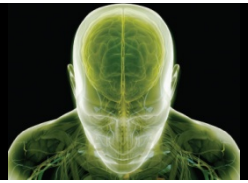


Direct Volume Visualization
DICOM versus RAW

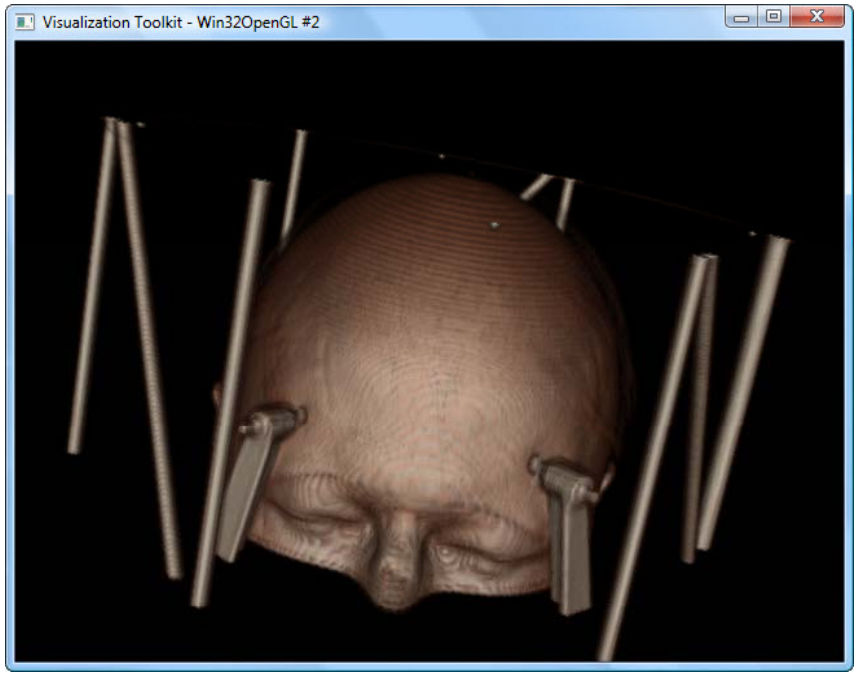


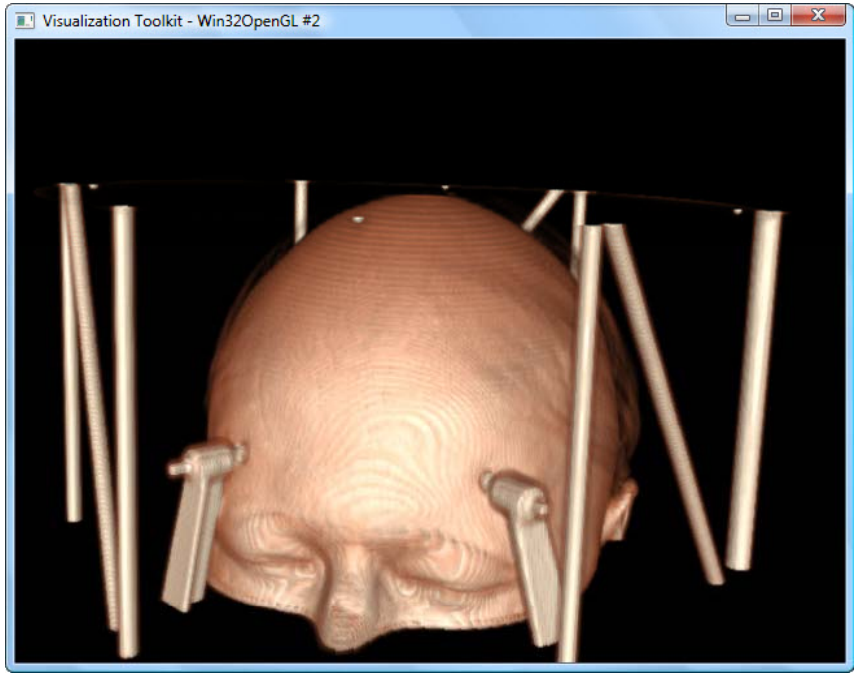


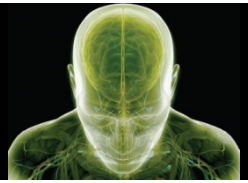




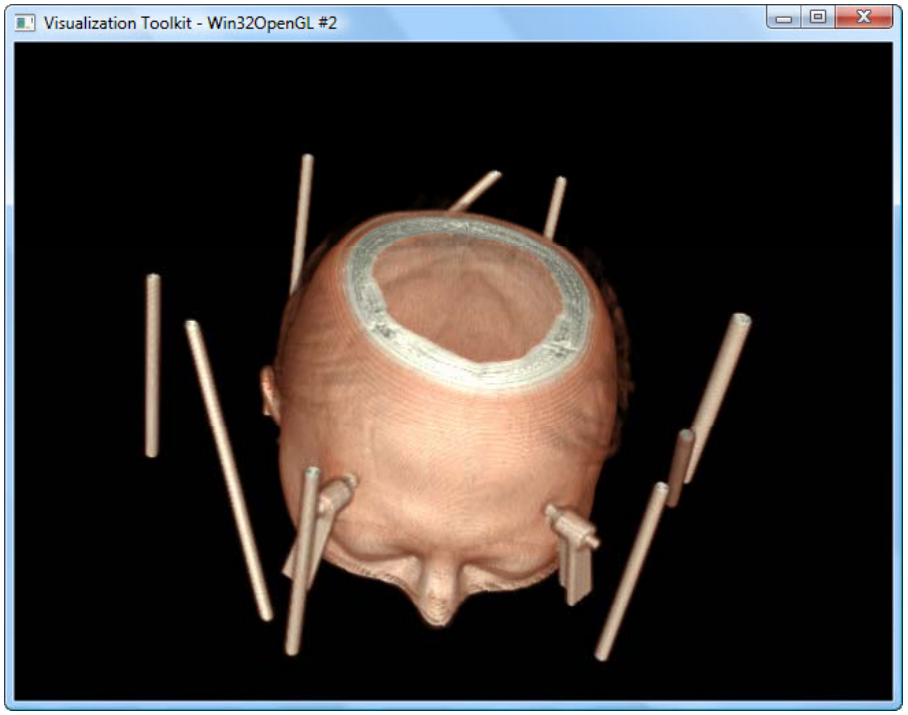
Direct Volume Visualization
VTK 5.6 versus VTK 5.4

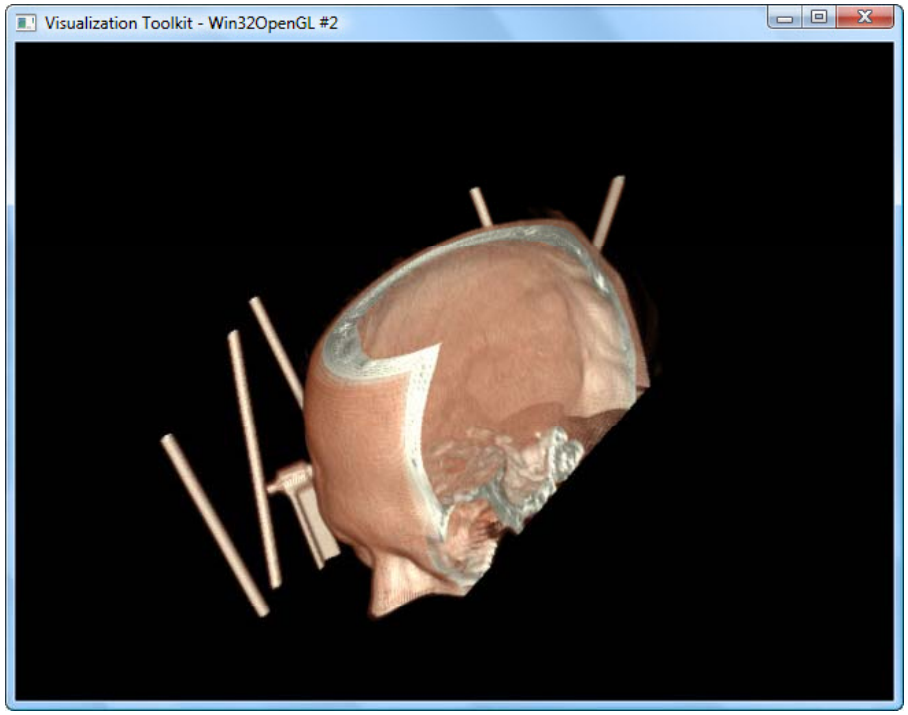


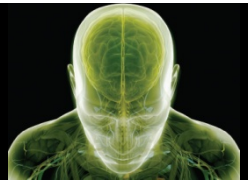




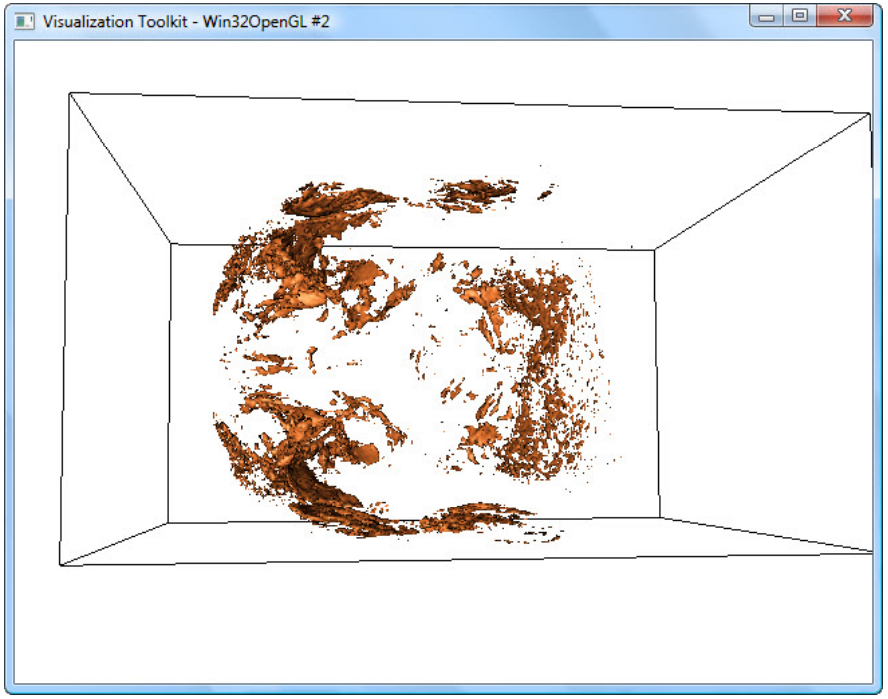
Cropping Options

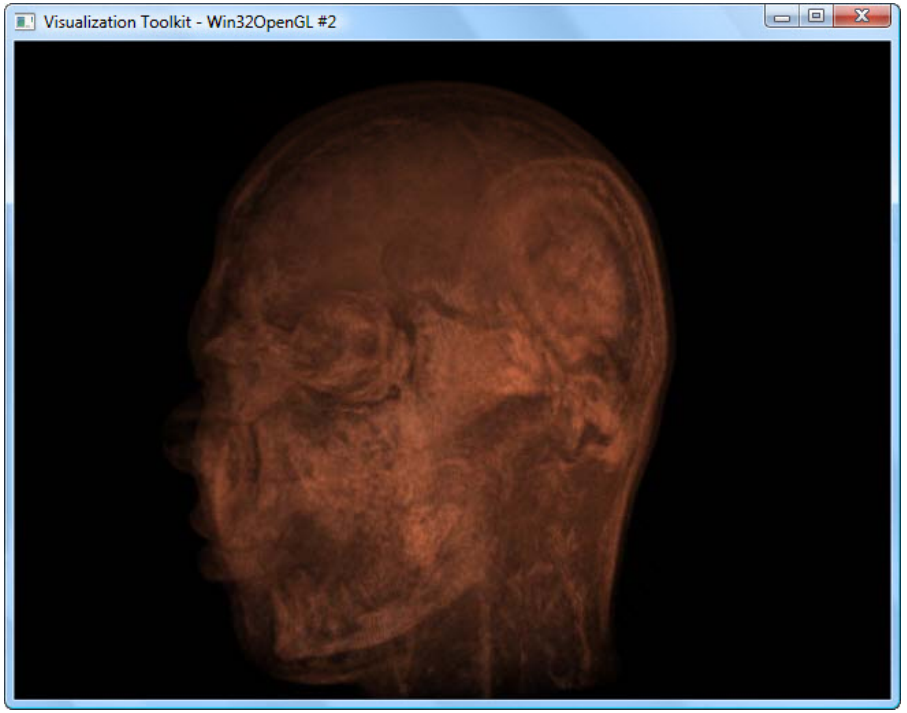


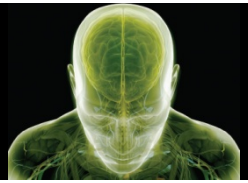




Using MR dataset (skin extraction and direct volume visualization)



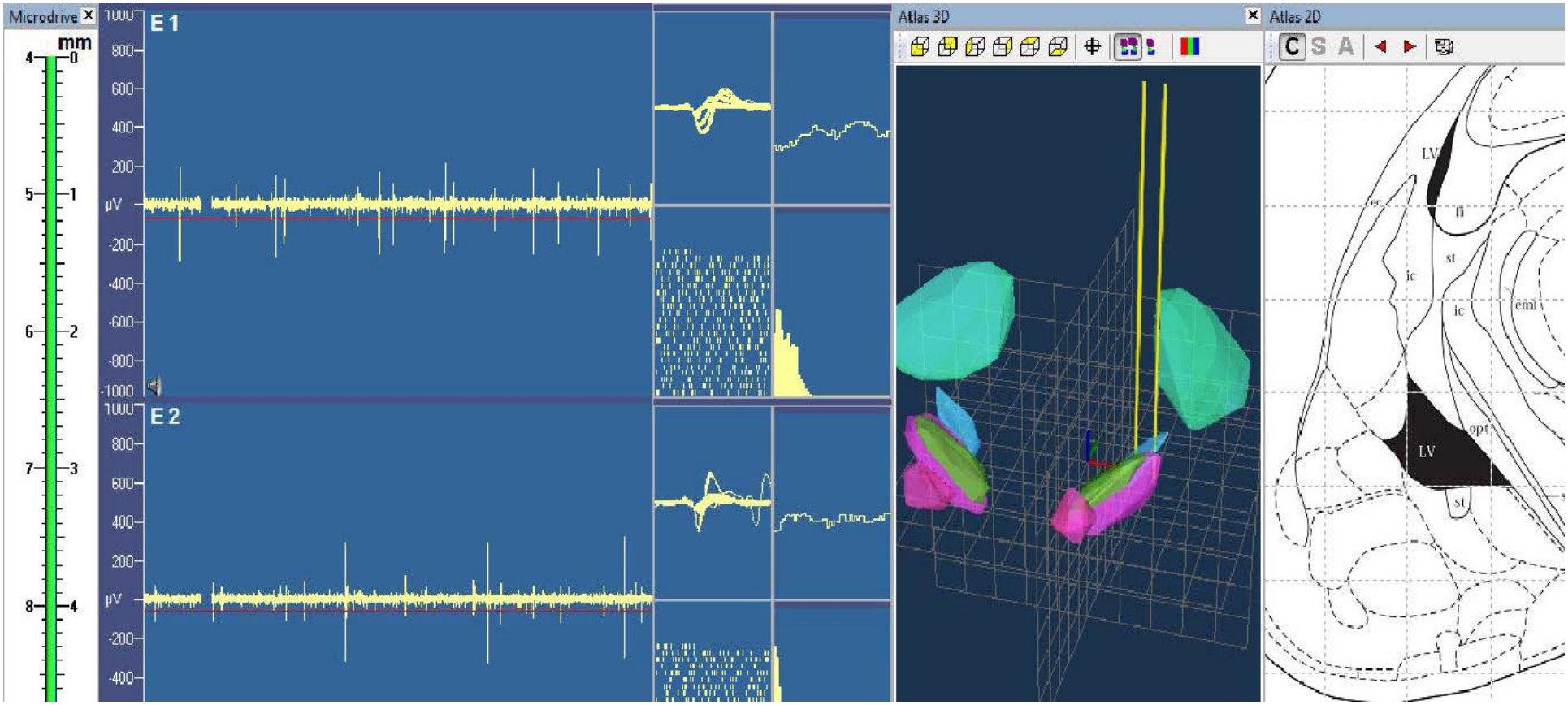




Conclusions

- medical imaging visualization
- How to improve volume rendering?
- Neurosurgery planning software

Neurosurgery Planning Software – Example for the future work



THANK YOU!