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 [0.60355525,0.60355525]
Slice Thickness (0018,0050) 1 DS [2]

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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:

- vtkVolume16Reader
- vtkVolumeRayCastMapper
  - SetVolumeRayCastFunction
  - SetSampleDistance
  - CroppingOn
  - SetCroppingRegionPlanes
- vtkVolumeRayCastCompositeFunction
- vtkPiecewiseFunction
  - AddPoint
- vtkColorTransferFunction
  - AddRGBPoint
- vtkVolumeProperty
  - SetColor
  - SetScalarOpacity
  - SetGradientOpacity
  - ShadeOn
  - SetAmbient
  - SetDiffuse
  - SetSpecular
- vtkRenderer
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!