Introduction to Medical Visualization

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360 Imaging – Symbyo Technologies
360 Dental Planning System
Visualization

Is to synthesize (generate) an image that describes numerical data.

In the medical field, advanced computer graphics techniques are used to generate realistic images of the medical data.
Space and Data

• Space
  – Where the data lives. (location and neighborhood)
  – Has its own dimensionality

• Data
  – A Space is always required
  – A discrete instance of the data at a specific position in space
  – Has its own dimensionality
Space and Data

- Neighborhood
  - 4-neighbors
  - 8-neighbors

- Topological Space
  - Triangle Mesh
CT Volume Data

- Format: (DICOM)
- Space Dimensionality: 3D
- Data Dimensionality: 1D

[Image of CT volume data with a 3D grid and a point labeled [1241] <- (ISO VALUE)]
Computer Graphics

description

Computer Vision

image
Computer Graphics

- Viewing Information
- Geometric Description
- Lighting Conditions

Rendered Image
Rendering a Cube
Graphics pipeline simple view
Geometric Description

Vertices are not the only thing for drawing a full fledged 3d object.

Other descriptions are there like texturing information, lighting information should be provided to draw a single 3d object.
Nvidia GeForce GTX 980 block diagram
Modern Graphics Pipeline
Crysis 3
Visualizing our data
Visualizing our data

- **LookUp Table**
- **2D Viewing**
  - MPR
  - Panorama
- **3D Viewing**
  - Volume Rendering
  - ISO-Surface Rendering
Visualizing our data

- LookUp Tables
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LookUp Tables (LUTs)

-1000 0 700 3000 5000

Air  Water  Bone

8-bit Grayscale monitor

ID LUTs
LookUp Tables (LUTs)

Different LUTs to emphasize and visualize areas suitable for drilling
LookUp Table (LUT)

Multi-dimensional LUTs
Visualizing our data

- LookUp Tables
- 2D Viewing
  - MPR
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- 3D Viewing
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  - ISO-Surface Rendering
MPR
Multiplanar Reconstruction

Axial
Coronal
Sagittal
MPR Multiplanar Reconstruction

Coronal

Axial

Sagittal
More MPRs
Panorama
Visualizing our data

• LookUp Tables
• 2D Viewing
  ○ MPR
  ○ Panorama
• 3D Viewing
  ○ Volume Rendering
  ○ ISO-Surface Rendering
Volume Rendering
3D Rendering

GPUs are designed to render triangles
3D Rendering

- Surface Extraction
- 3D Surface
- Direct Rendering
- 3DVolume Data
- Rendered Image
- Slicing
- Ray Casting