3D Reconstruction of Individual Anatomy From Medical Image Data: Rendering

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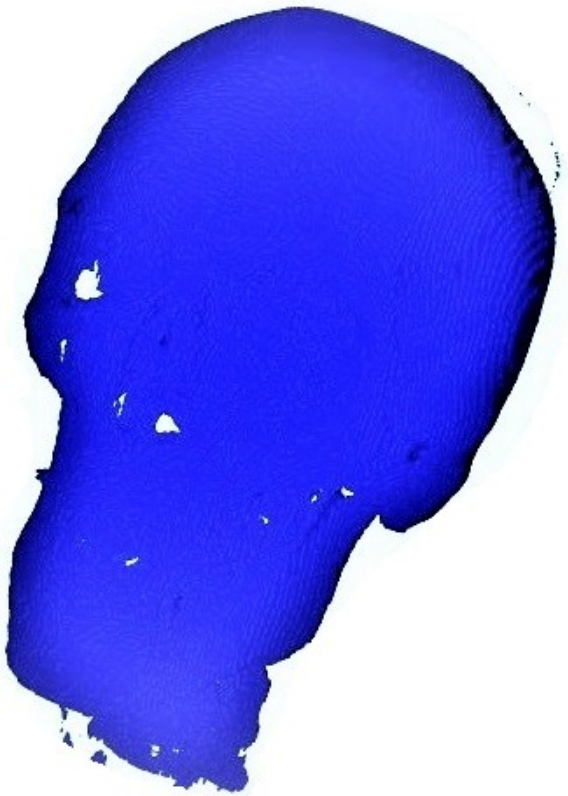
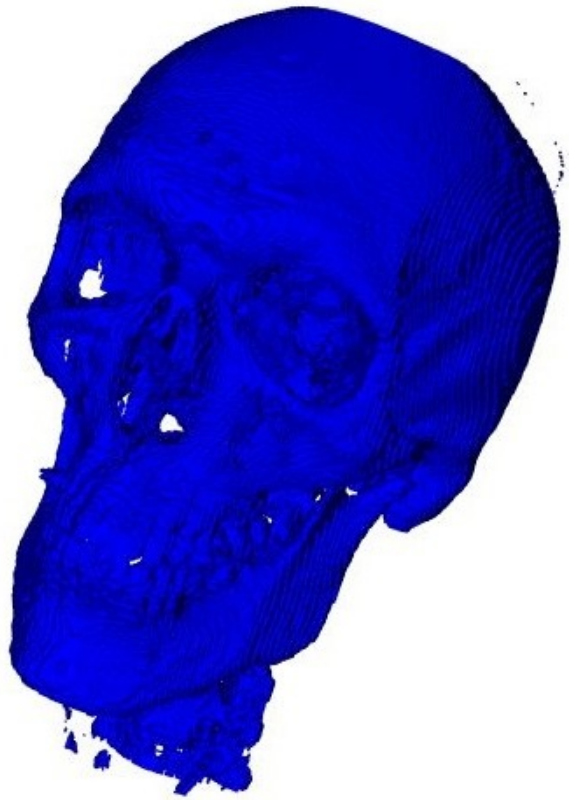
Introduction

Previously



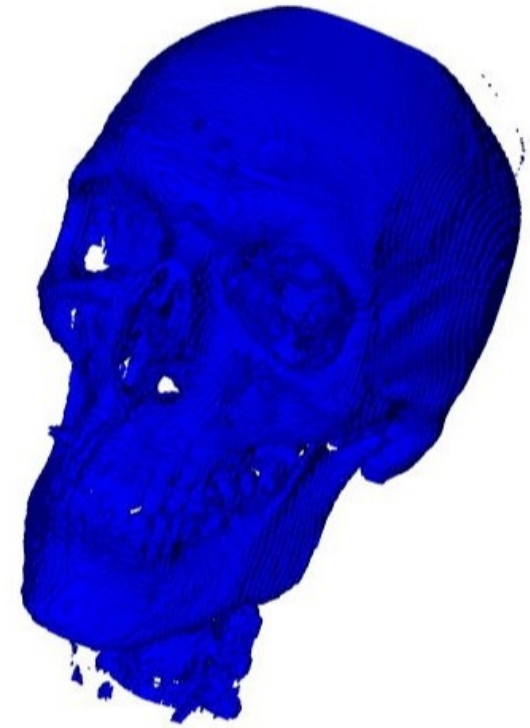
No Shading



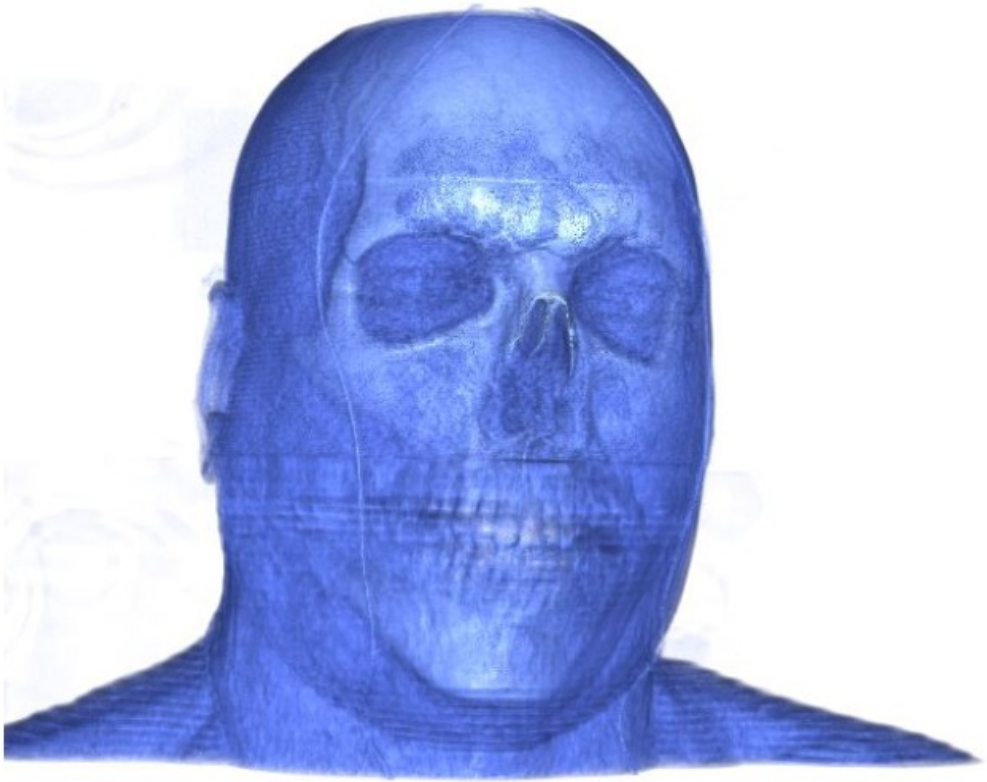
Shading

After the last meeting, you should've understood the method of extracting surface from clinical image data.

Advanced Rendering



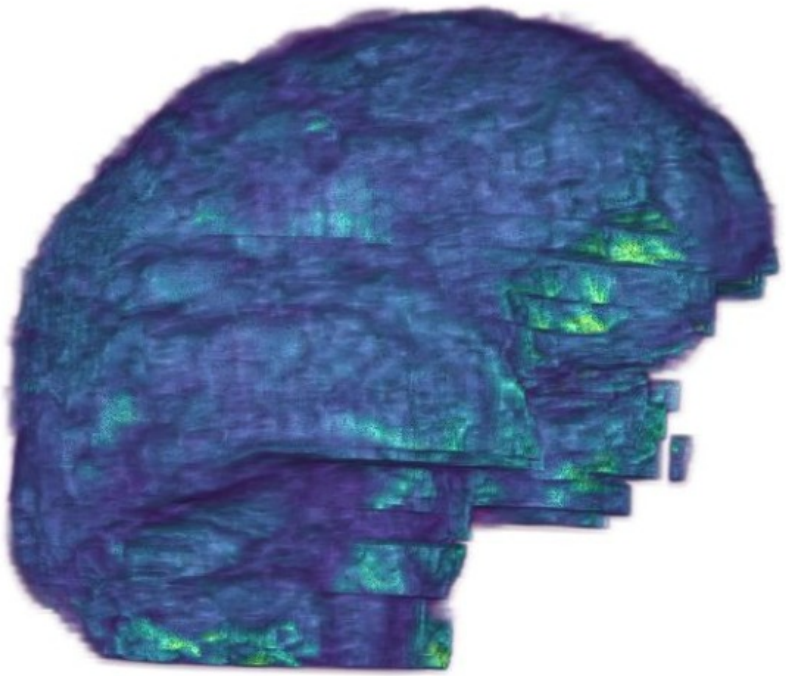
Surface Rendering



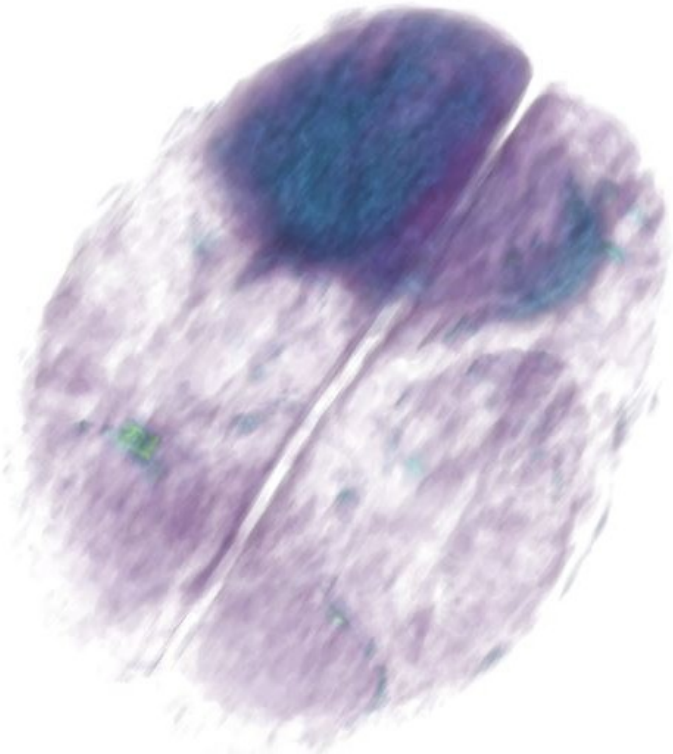
Volume Rendering

For clinical research data treability and visualization, there are two main rendering methods.

The main objective



Surface Extraction



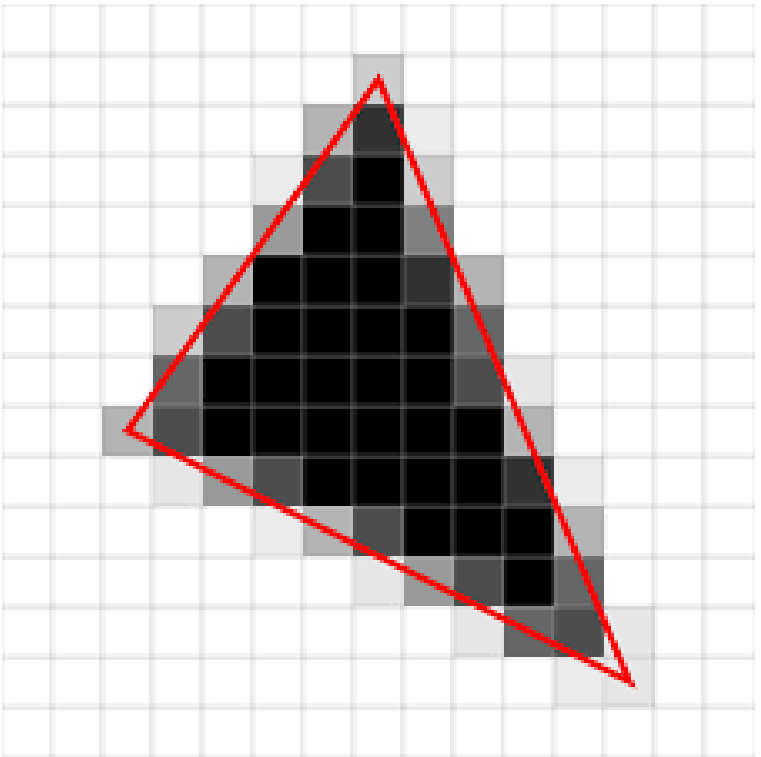
Tumor Visualization

This post will present the fundamental concepts of graphics rendering from clinical images.

Knowledge Base

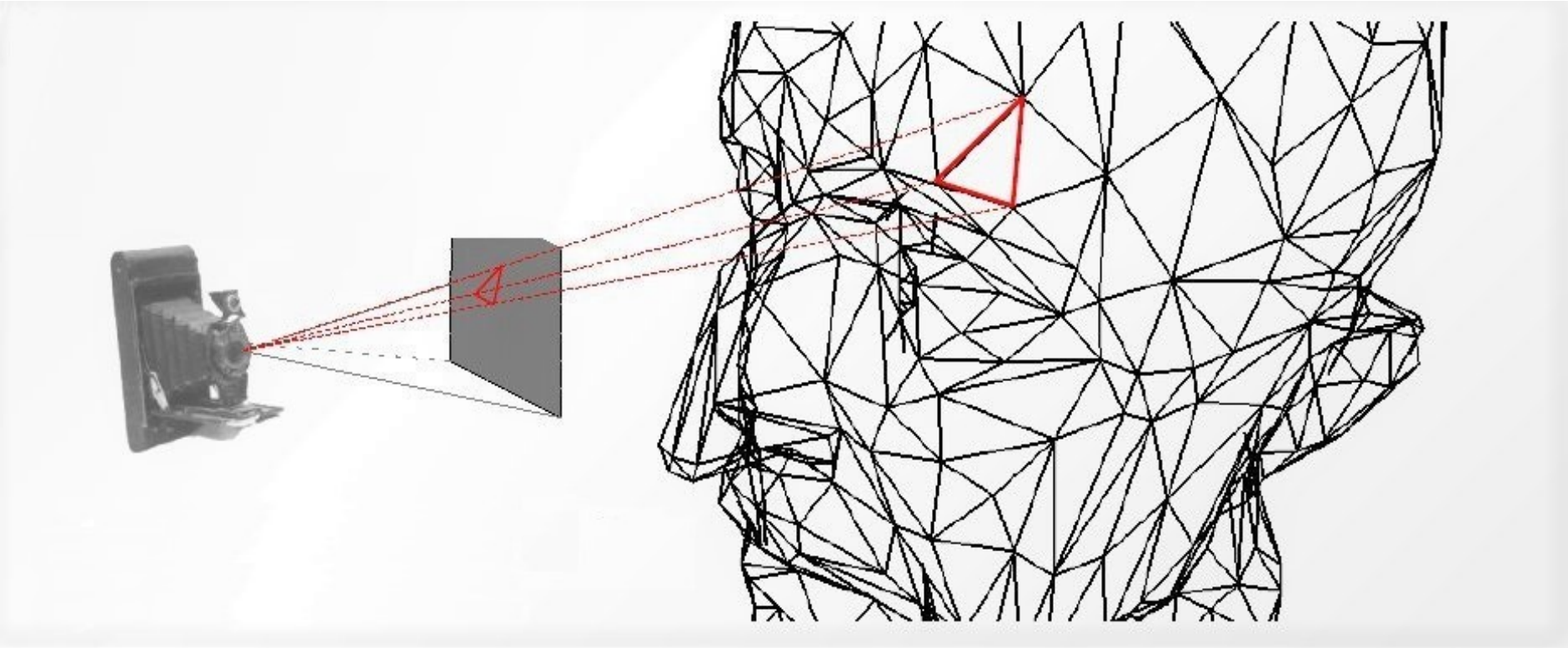
Rasterisation

- Rasterisation is the task of taking an image described in a vector graphics format (shapes) and converting it into a raster image.
- Rasterisation is simply the process of computing the mapping from scene geometry to pixels and does not prescribe a particular way to compute the color of those pixels.
- The specific color of each pixel is assigned by shading.



Rasterization: a Practical Implementation

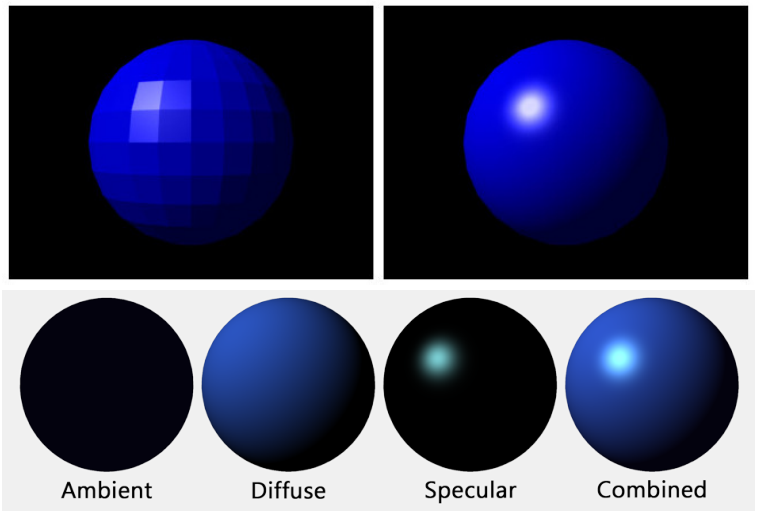
Surface Rendering



Surface rendering is an advancement in the method of interpreting data-sets by generating a set of polygons that represent the anatomical surface, and displaying a three-dimensional model representation.

Shading

- Shading is referred to as the implementation of the illumination model at the pixel points or polygon surfaces of the graphics objects.
- The shading model has two primary ingredients: properties of the surface and properties of the illumination falling on it.
- There are three light intensities and each of them contributes to a reflection component.



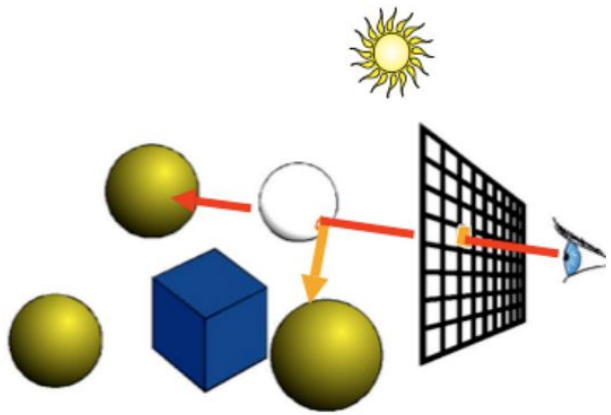
Ray Tracing

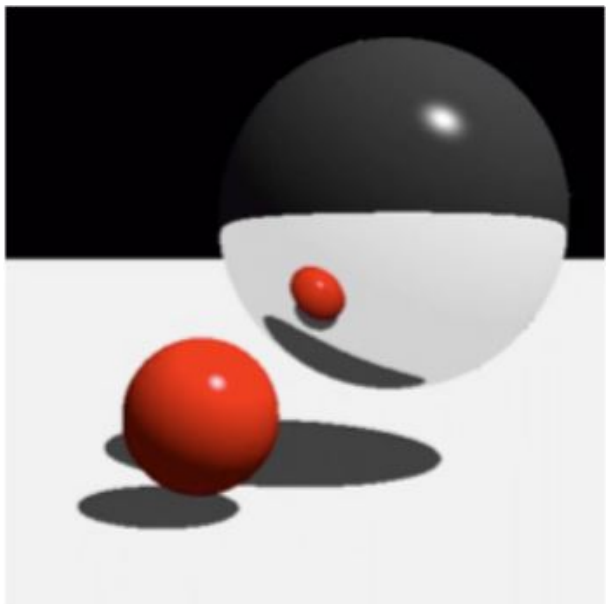
A computer graphics algorithm published in the **1979 ACM** proceedings by T. Whitted.
Approach:

- In the real world, the light may reflect from one object to another and change as it passes through transparent or semi-transparent objects.

Idea:

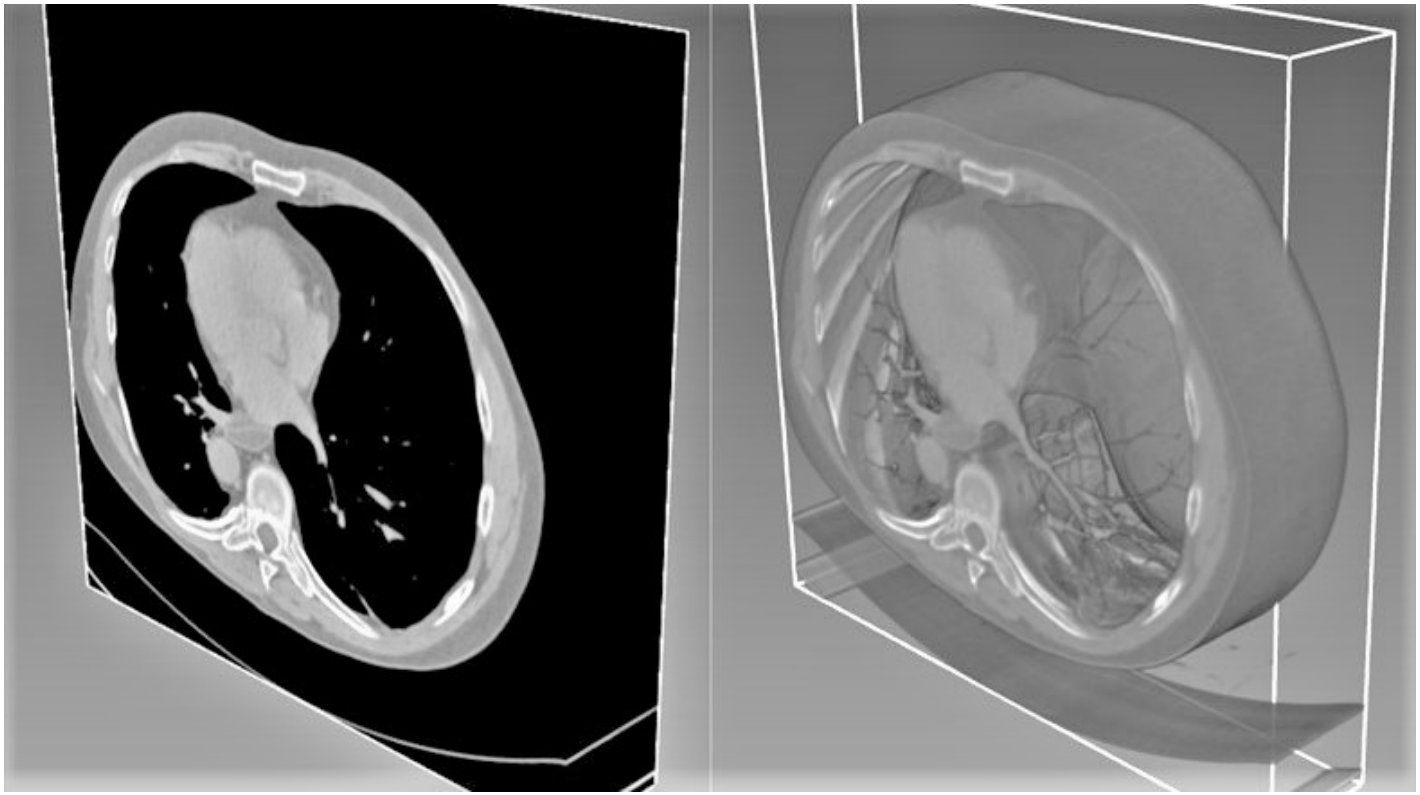
- The objects are illuminated by beams of light.
- Follow the path of those beams backwards.





Demo

Volume Rendering



Volume rendering is a technique for visualizing sampled functions of three spatial dimensions by computing 2-D projections of a colored semitransparent volume.

Volume Visualization With Ray Casting

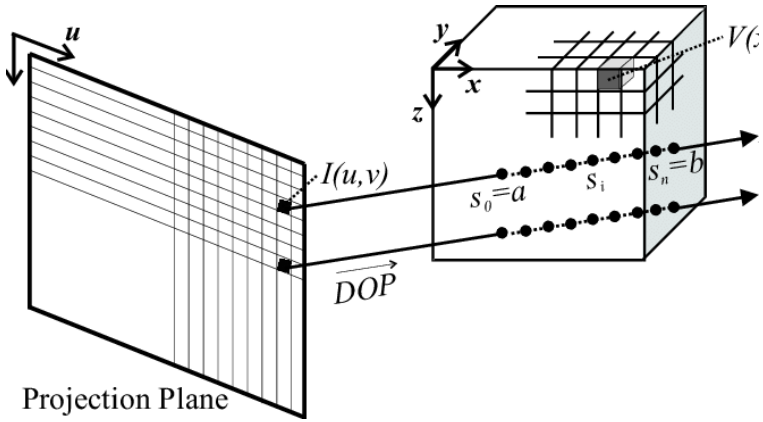
Volume Ray Casting

A computer graphics algorithm published in the **1995 IEEE** proceedings by Max.
Approach:

- Push the computation through the object, sampling the object along the ray.

Idea:

- For each pixel of the final image, a ray of sight is shot through the volume.
- The volume being touched and enclosed within a bounding primitive.



Volume Rendering Techniques

Shear-Warp Algorithm

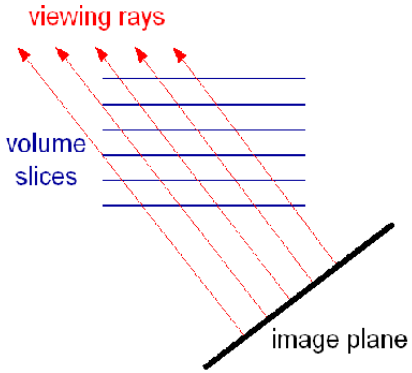
A computer graphics algorithm published in the **1994 SIGGRAPH** proceedings by Philippe Lacroute.

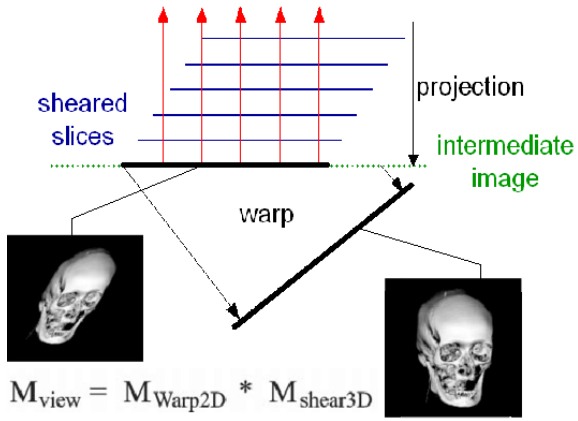
Approach:

- Simplify the projection by first shearing, then projecting and finally warping the viewed points.

Idea:

- Shear and resample the slices.
- Project resampled voxel scanlines and warp into the final image.





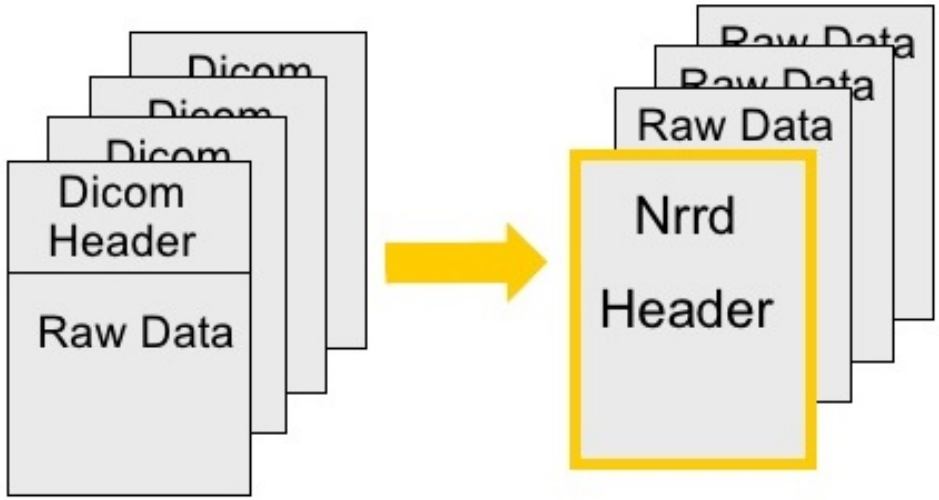
Lacroute Shear-Warp

Dataset

NRRD Standard

NRRD is a library and file format for the representation and processing of n-dimentional raster data.

- NRRD format includes a single header file and image file that can separate or combined.
- NRRD header represents N-dimensional raster information.



Development

Desktop App

Pros:

- Best designed C++ GUI application framework.
- Stable on all major platforms.
- Huge community base.

Cons:

- UI platform inconsistency.
- No third-party extension.
- Complicated build process.
- Under Lesser General Public License.

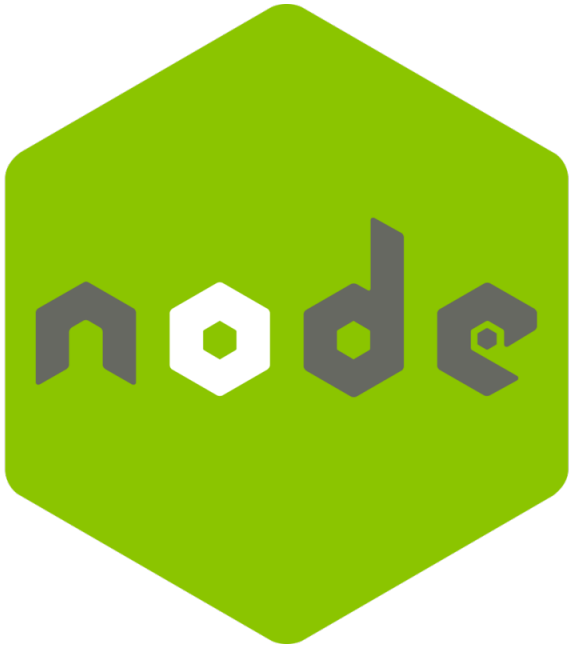
Web App

Pros:

- Asynchronous event driven IO helps concurrent request handling.
- Various commonly used tools.
- Freedom to develop the apps and software.
- Active and vibrant community.

Cons:

- Not suited for CPU-intensive tasks.
- Complicated relational database dealing.
- Does not have a strong library support system.

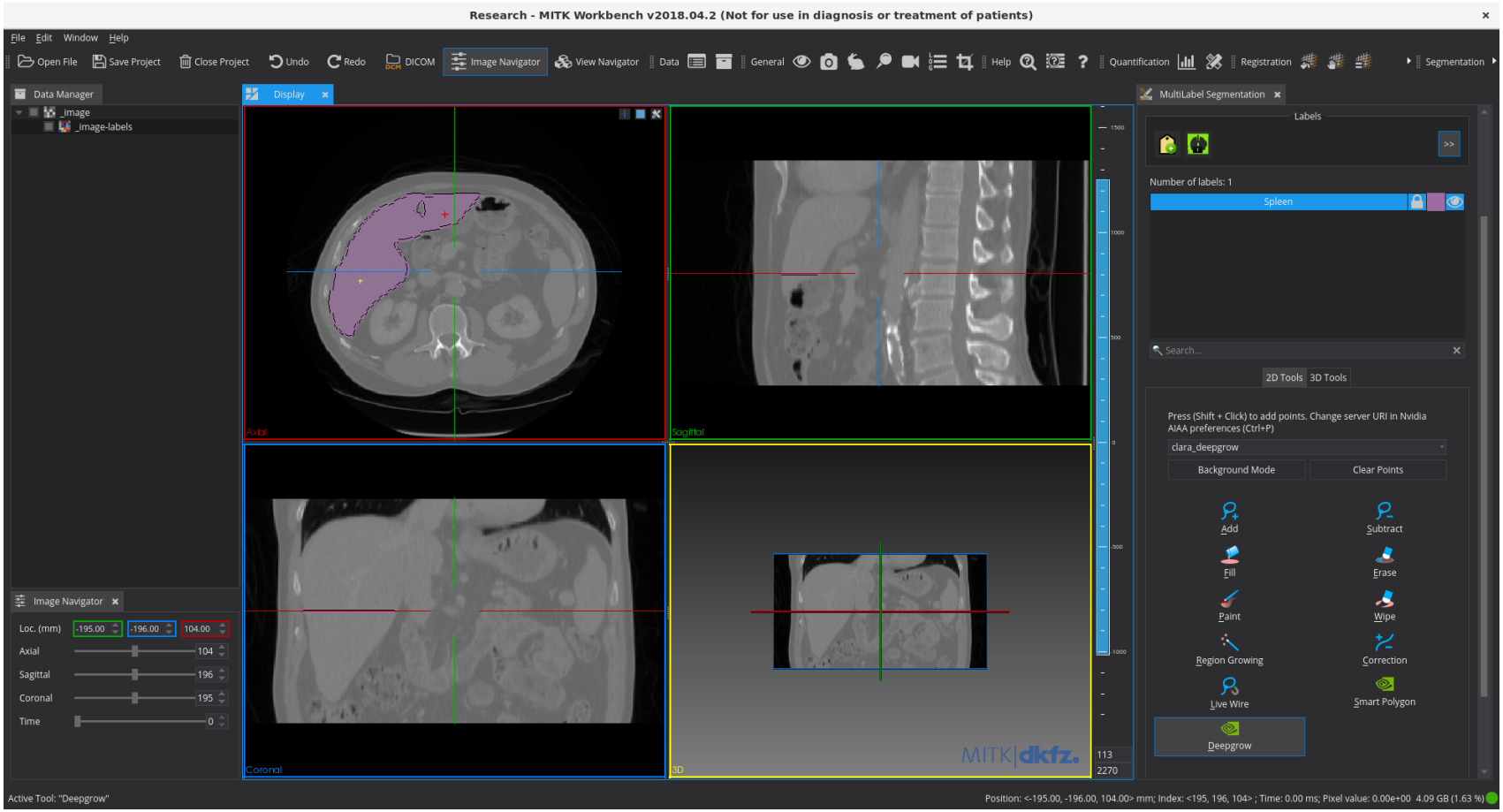


Application

Medical Imaging Interaction

A medical imaging interaction application must provides several tools:

- Loading and saving various type of data.
- Multiple, consistent views on the same data.
- An interaction concept based on state machines.
- An undo/redo concept for interactions.
- Organization of all application data in a central, hierarchical repository.
- Description of data items by arbitrary properties.



The Medical Imaging Interaction Toolkit

The End

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