

GRAPE:

A volume visualizer for Geant4 Medical Application

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Motivation of development (1)

- ▶ Geant4 Medical Application
 - Visualization of medical data
 - = **Volume visualization**
 - = surface shape + inside structure

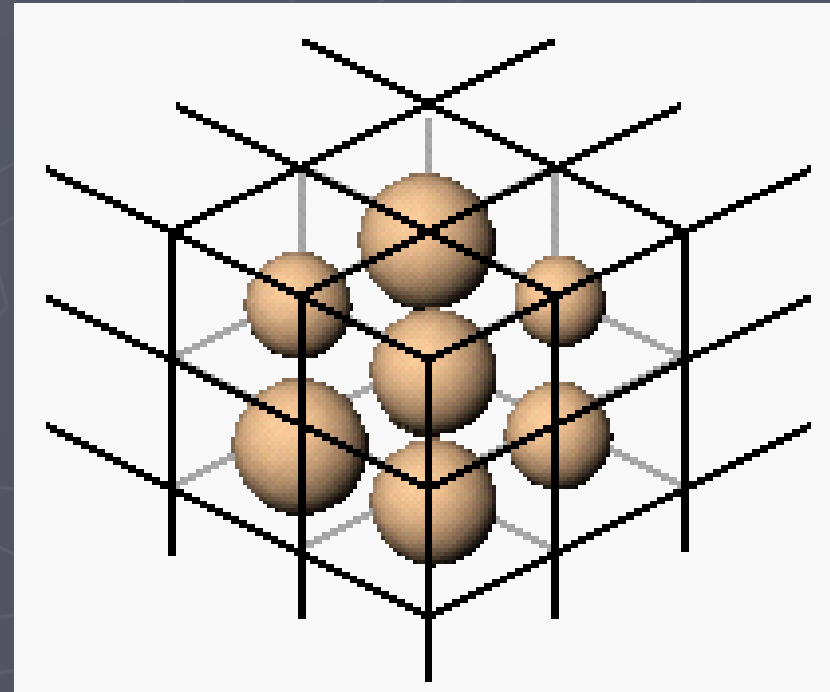


Motivation of development (2)

- ▶ Conventional options of Geant4 visualization:
 - OpenGL, DAWN, VRML, Ray Tracing, OpenInventor, OPACS, WIRED, etc.
 - → Polygon-based visualization
 - → Surface visualization
 - → Not suitable for medical data
- ▶ We need to introduce "volume visualization" into Geant4

What is volume visualization? (1)

- ▶ Semi-transparent visualization of voxel data (grid data or lattice field)
- ▶ Voxel = lattice point with a field value
- ▶ Field value
= local density of human body (CT data)

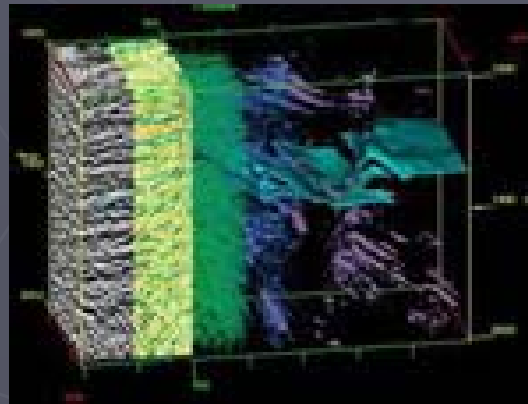


What is volume visualization? (2)

- ▶ Physical model
 - Volume data = half-transparent gel
 - The gel consists of particles
 - → Field value = density of human body (CT)
= number of particle
- ▶ Based on the above model, intensity of light passing through the lattice space is calculated.
 $\propto \text{opacity}$
- ▶ Ray-casting algorithm

What is volume visualization? (3)

- ▶ Applicable area of volume visualization
 - Medical data
 - Fluid (water, gas, etc)
 - Volume CAD



Strategy of Geant4 Volume Visualization

- ▶ Medical data (CT or MRI)
- ▶ → Geant4 DICOM interface
 - developed by A. Kimura, et. Al
 - `$G4INSTALL/examples/extended/medical/DICOM`
- ▶ → Geant4 Kernel (simulation)
- ▶ → GRAPE-format file
 - CT-DATA + Dose distribution
(geometry) (energy)
- ▶ → GRAPE (our volume visualizer)

Functions of GRAPE

- ▶ 3D volume visualization (main screen)
 - Fast and high quality
 - Source-codes are tuned with assembler
 - No need to introduce special graphics hardware
 - Interactive visualization of 256^3 data with PC
- ▶ 2D MPR (XY, YZ, and ZX slices)
 - Interactive display of dose values
- ▶ Interactive opacity control
 - Tuning of transfer function

Snapshot of GRAPE (1)

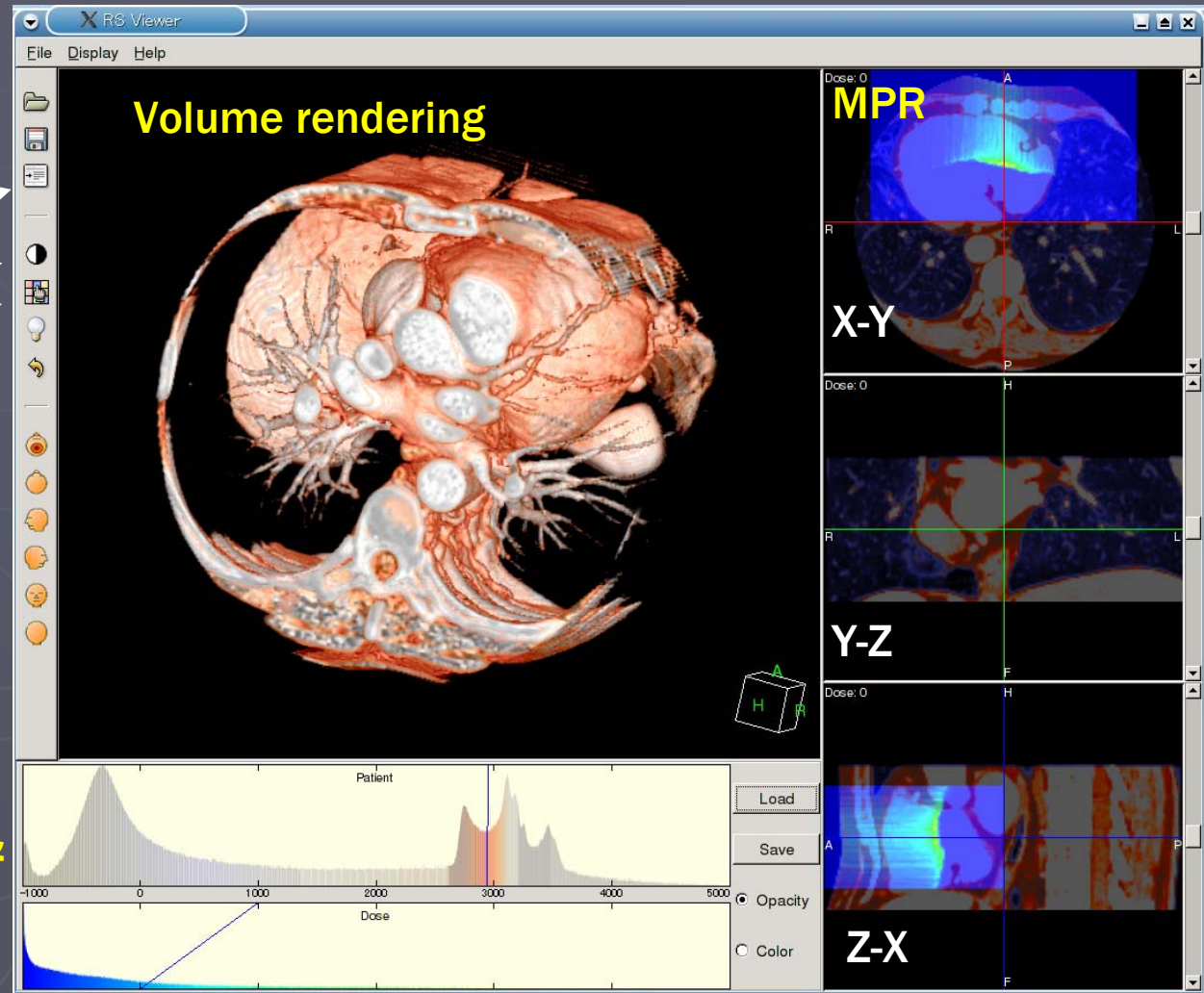
Tool bar

- Open file
- Save as image
- Data information

- MPR contrast
- 3D Resolution
- 3D Light
- 3D Reset

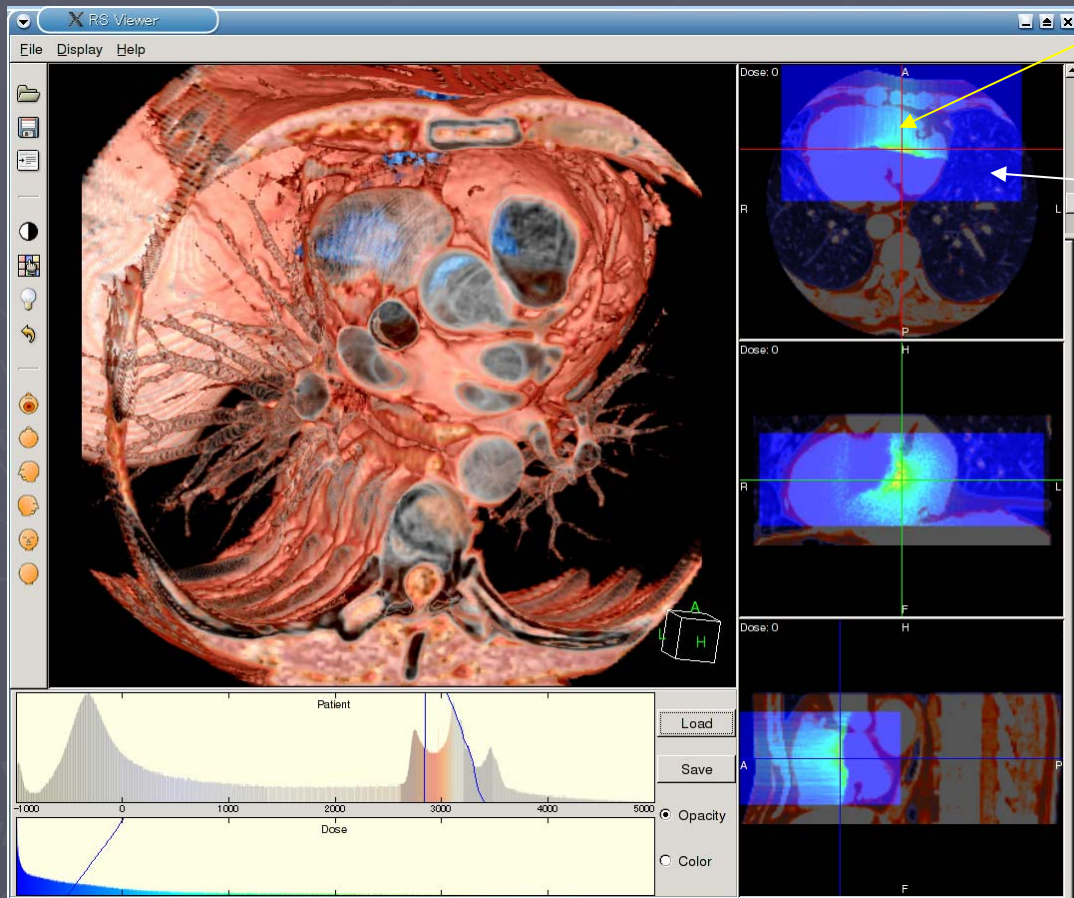
Directions

Transfer function & color map setting



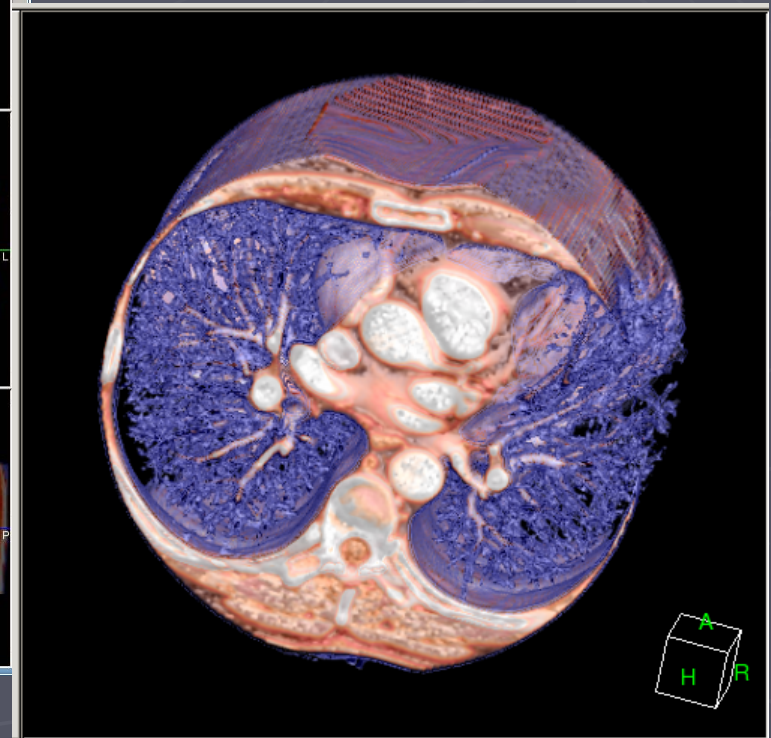
Snapshot of GRAPE (2)

► Samples in different settings.



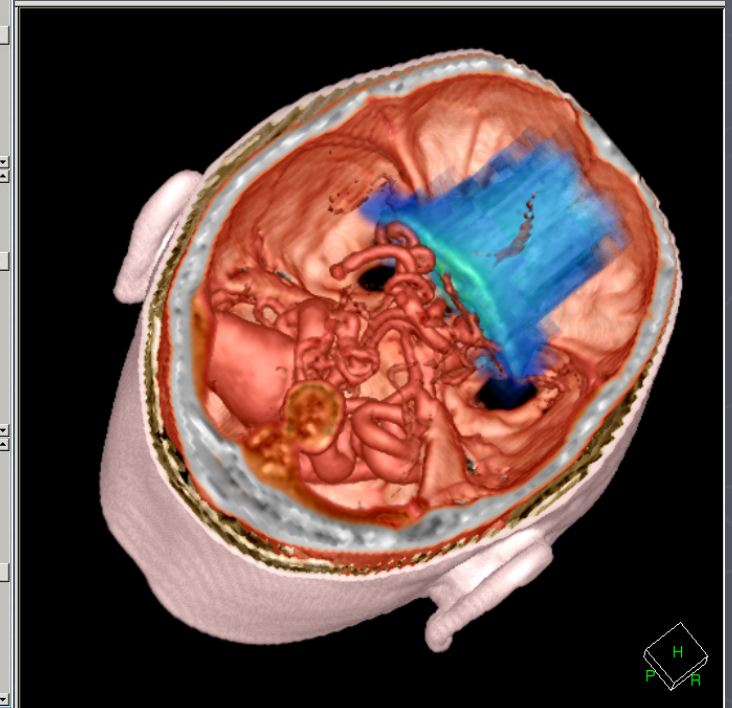
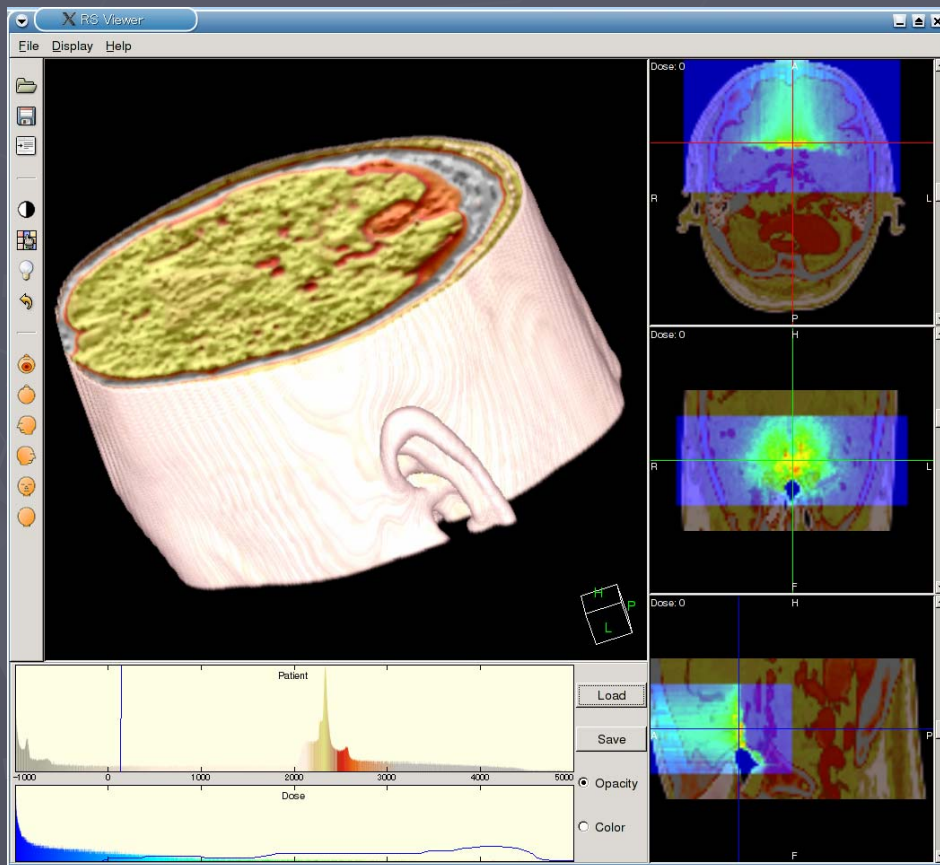
If user pick a point in the dose map region, its dose value is displayed.

Dose map region



Snapshot of GRAPE (3)

- ▶ A head region data.



System Requirements

- ▶ OS
 - Linux or Windows 2000/XP
- ▶ CPU
 - Intel Pentium4 or faster
- ▶ Main memory
 - 1 GB
- ▶ Video
 - OpenGL hardware (recommend)
- ▶ HDD
 - 100MB

Official release of GRAPE

- ▶ WHEN: End of March, 2006.
- ▶ WHEKE: KEK Web site
- ▶ Sample codes to generate a GRAPE-format file will be released together with Geant4.
 - `$G4INSTALL/examples/extended/medical/`

Future plan of Geant4 volume visualization

► Hardware acceleration

- Real-time volume rendering
- VolumePro (TeraRecon co.)
 - Graphics hardware widely used in medical field
- GPU (graphics processing unit)
 - No need to buy additional hardware
 - Available memory space is increasing.
 - Now 512 MB,
 - Soon 1GB

GRAPE development team

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- ▶ Ayumu Saito (JST, Ritsumeikan Univ.)
- ▶ Satoshi Tanaka (Ritsumeikan Univ)

- ▶ KGT co.