diffusion

Tensor

Visualizer

II Second **R**elease

by **UTRAD/ICAL**

dTV.II

What is dTV? What can I do with dTV?
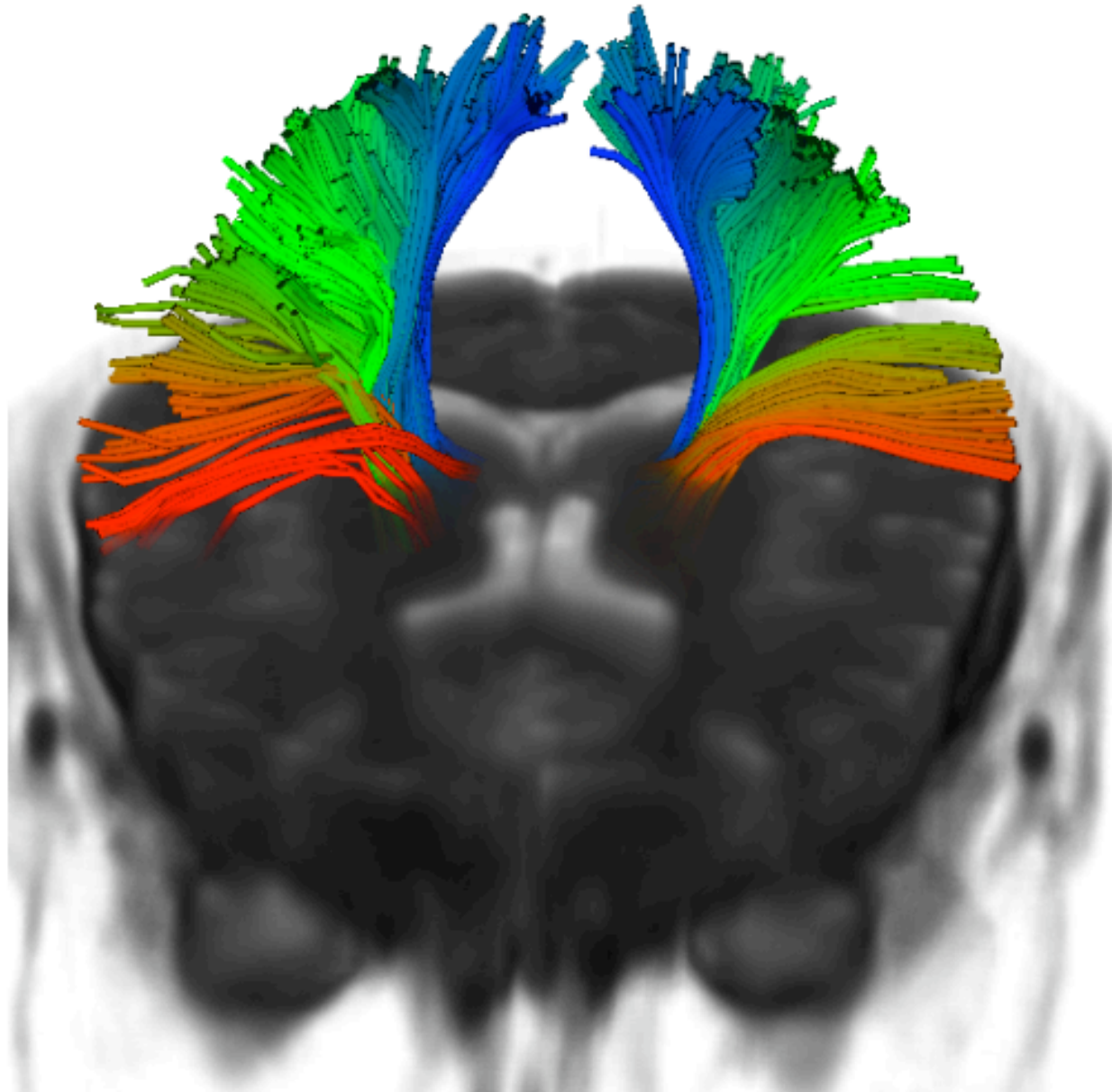
Fiber tracking trajectory tubes displayed with volume-rendering of b=0 image

(diffusion MRI data set pre-processed for SLF-cancel [3,4])

- **dTV** is a plug-in software for a general-purpose volumetric image data viewer, **VOLUME-ONE** [1].

- Based on diffusion MRI analysis, **dTV** produces graphic objects such as fiber trajectory lines displayed with other graphics objects in **VOLUME-ONE**.

- You can perform diffusion MRI-related studies such as fiber tracking, ROI analysis, etc. [2]

- Currently, second release of version II (**dTV.II SR**) is open to public

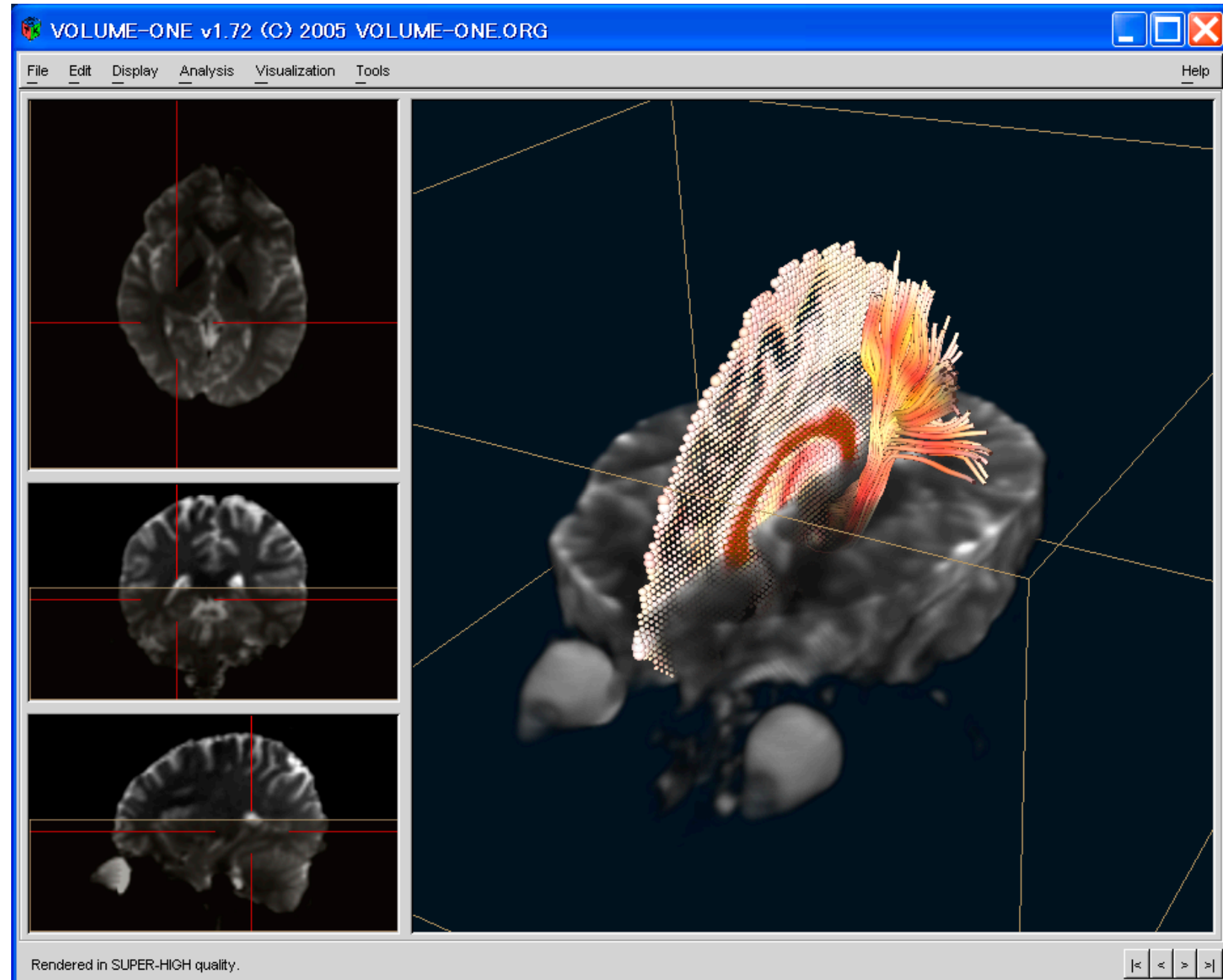- **dTV** and **VOLUME-ONE** softwares are currently for Win32 environment only.

dTV at a Glance

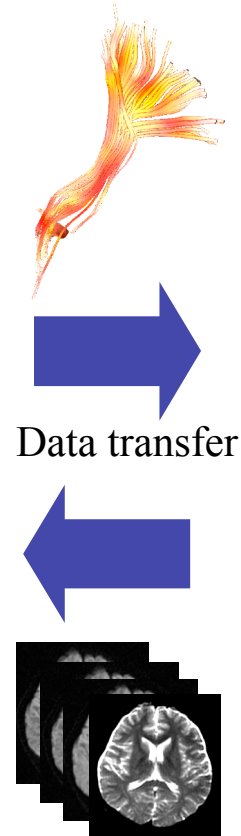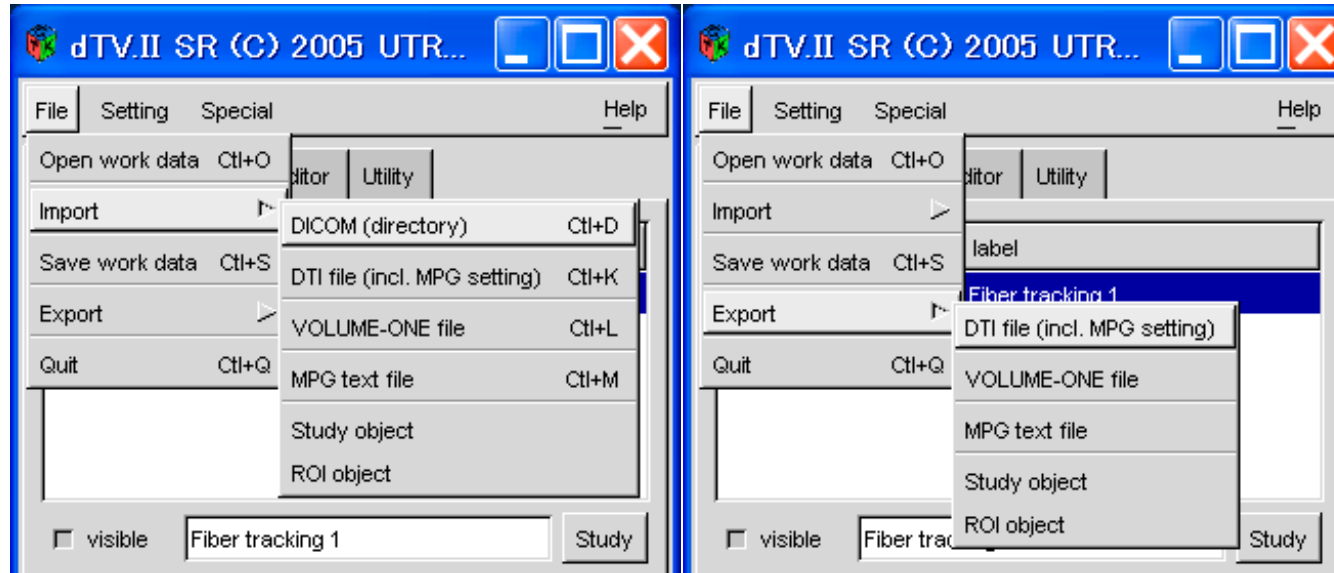Analyze diffusion MRI, create graphics objects, and transfer them to VOLUME-ONE

Display multi-channel volume data with graphics objects such as 3D-texture for volume rendering

Data transfer
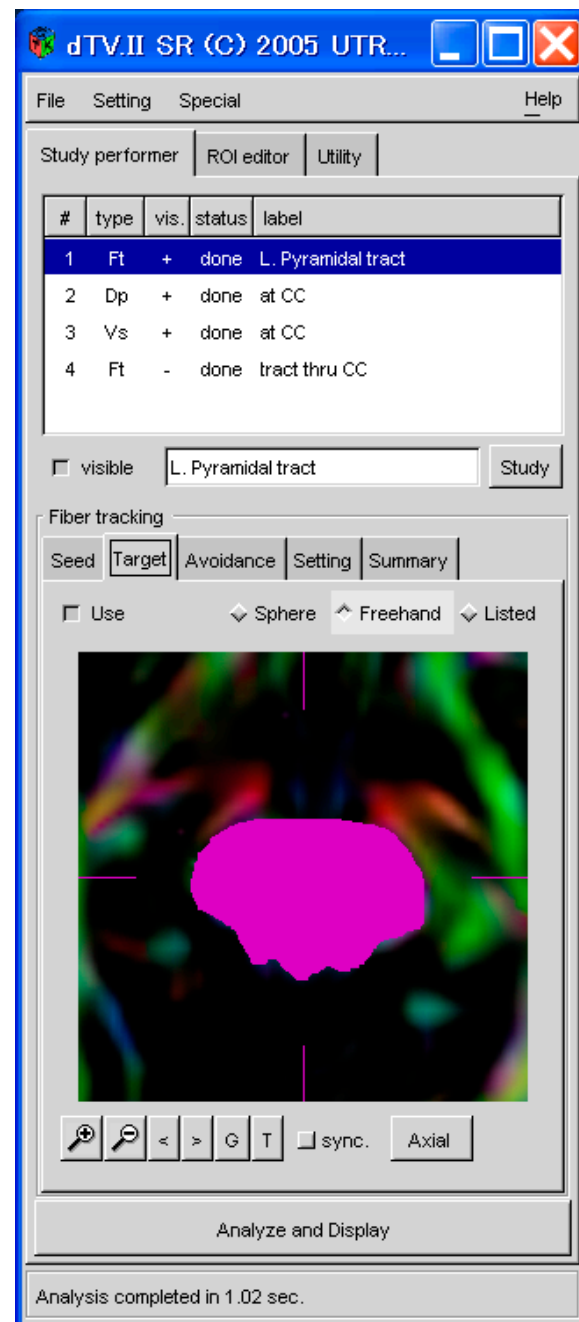
dTV as **plugin** for VOLUME-ONE

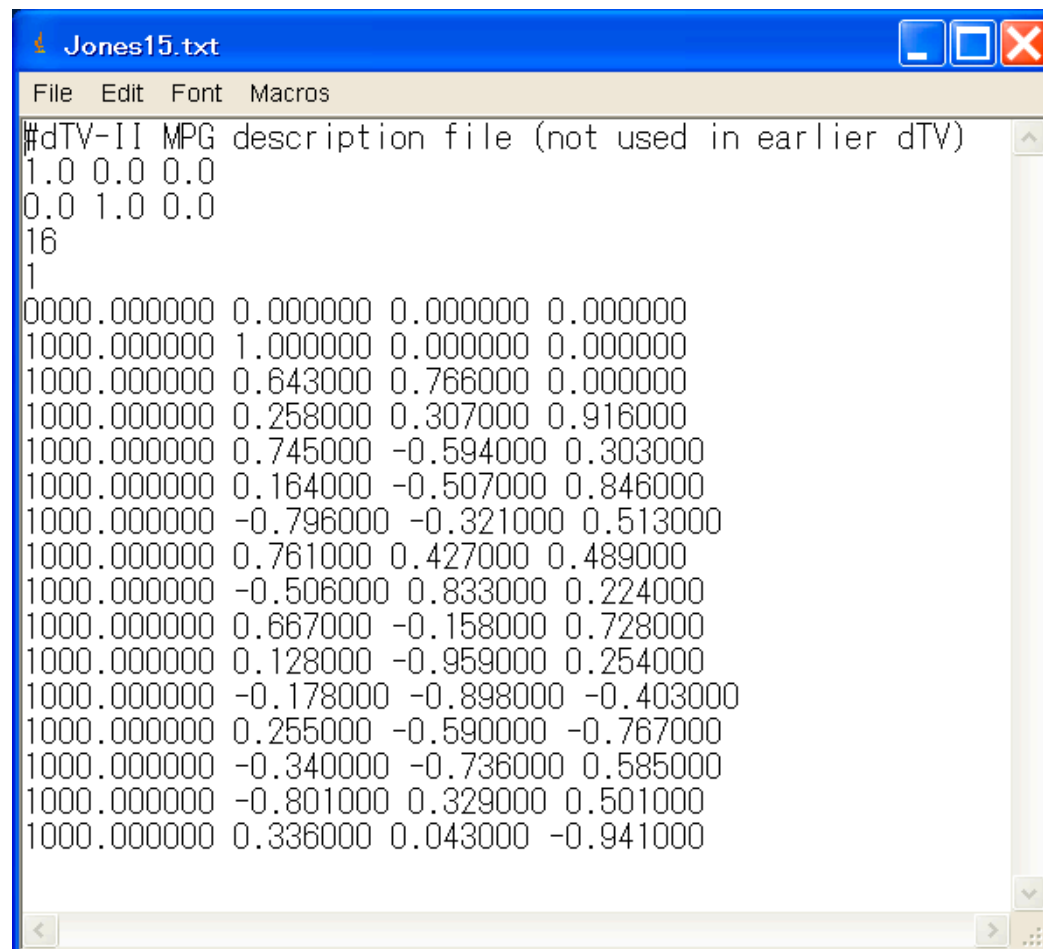VOLUME-ONE: General purpose volume data viewer

Data Load and Save


File import menu

File export menu

MPG text file example

- Load MRI files
  - dTV: DICOM, raw, etc.
  - VOLUME-ONE: Analyze, raw, etc.
- Load MPG setting data
  - Text file format
- Export volume data
  - Voxelized tract, etc.
- Import MRI volume data set loaded in VOLUME-ONE
  - Transfer data to dTV automatically when dTV is launched
- Save session data as a file
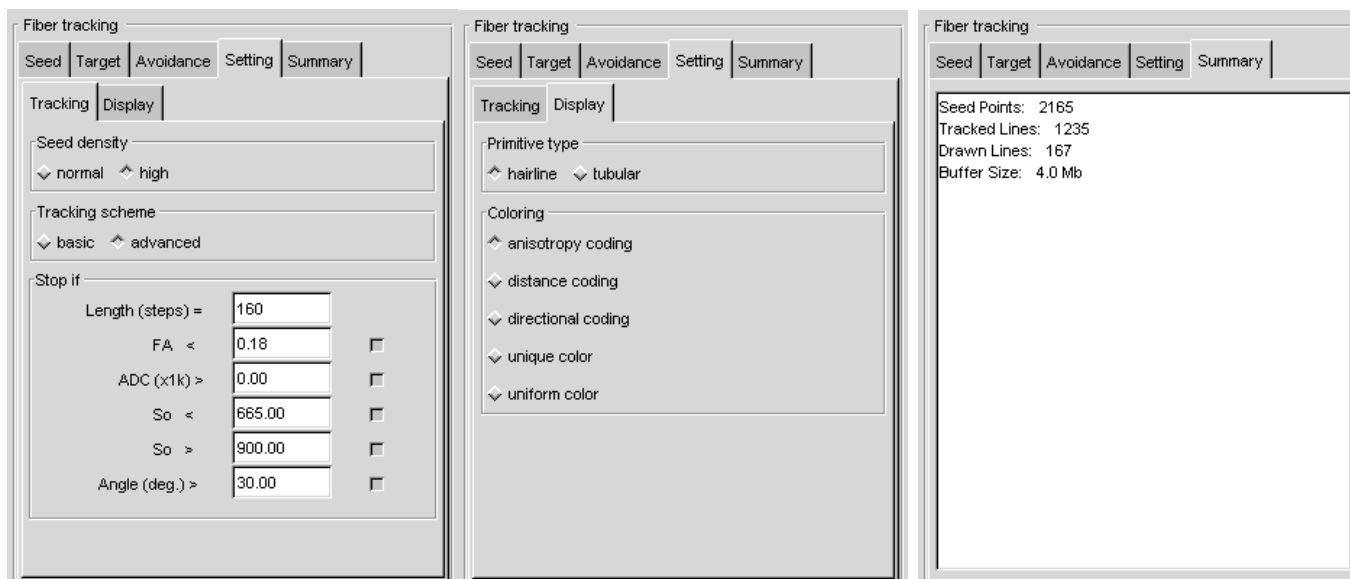 - incl. settings and results for fiber tracking, ROI analysis, etc.

Fiber Tracking
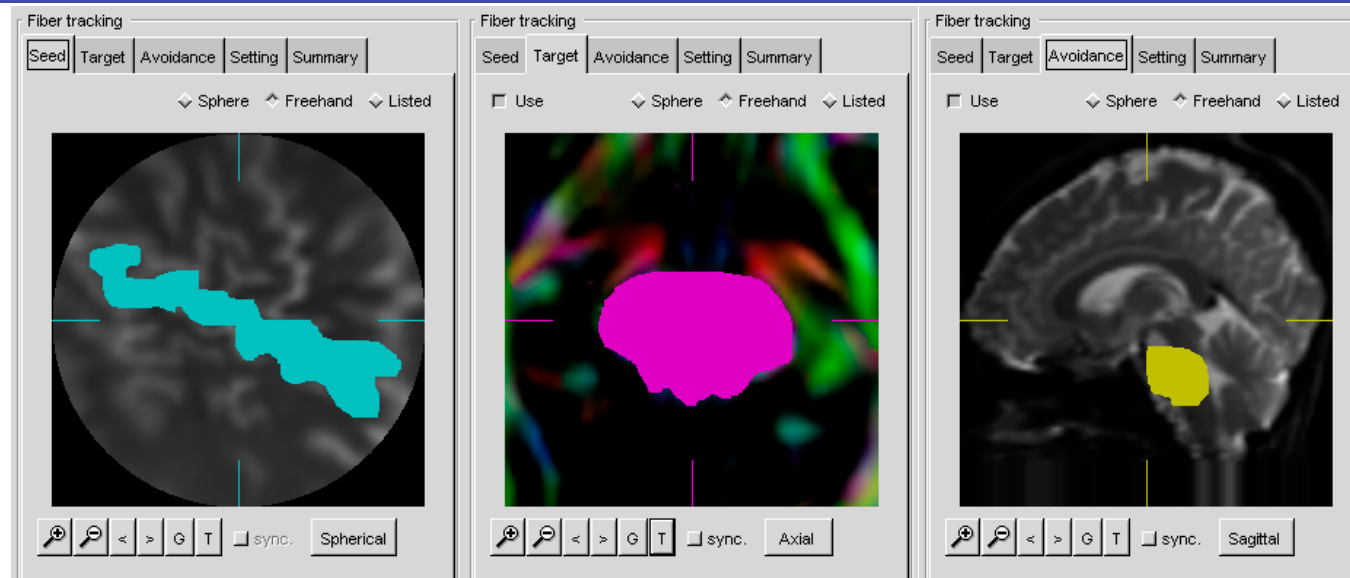
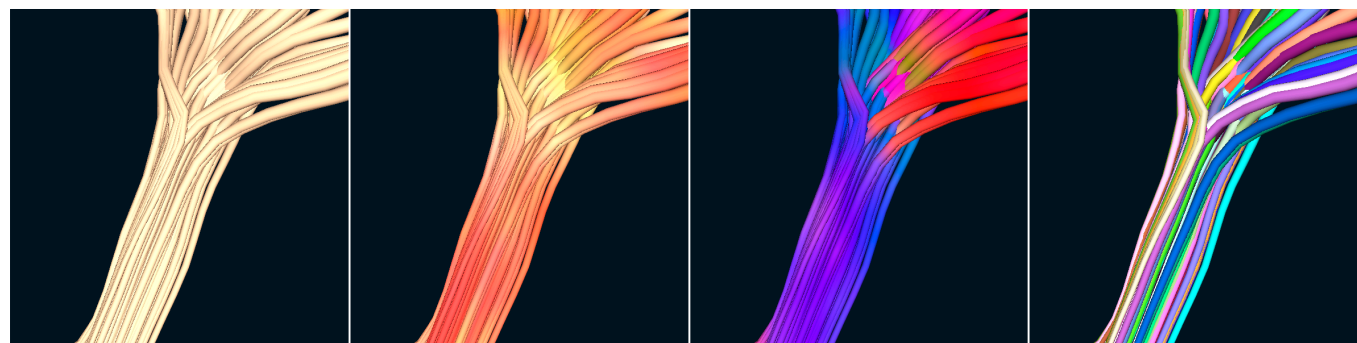seed

target

avoidance

tracking setting

display setting

summary

various types of trajectory coloring

- ROIs
  - 3 function types
    - Seed: tracking start points
    - Target: must pass through
    - Avoidance: must NOT pass through
  - Sphere, freehand curve, etc.
  - Set on various plane (axial, sagittal, etc.) of several types of images (b=0, FA, etc.)
  - Single or multi on list of ROI editor
  - Semi-auto capture by region-growing
- Settings
  - Seed point density
  - Two tracking algorithms
    - Basic : e_1 tracer
    - Advanced: modified tensor-line
  - Tracking termination criteria
    - FA, ADC, S_0 (b=0 signal), and angle
  - Trajectory primitives
    - tubes or hairlines
  - Trajectory colorings
    - Uniform, diffusion anisotropy-coded, fiber orientation, etc.
- Summary for tracking

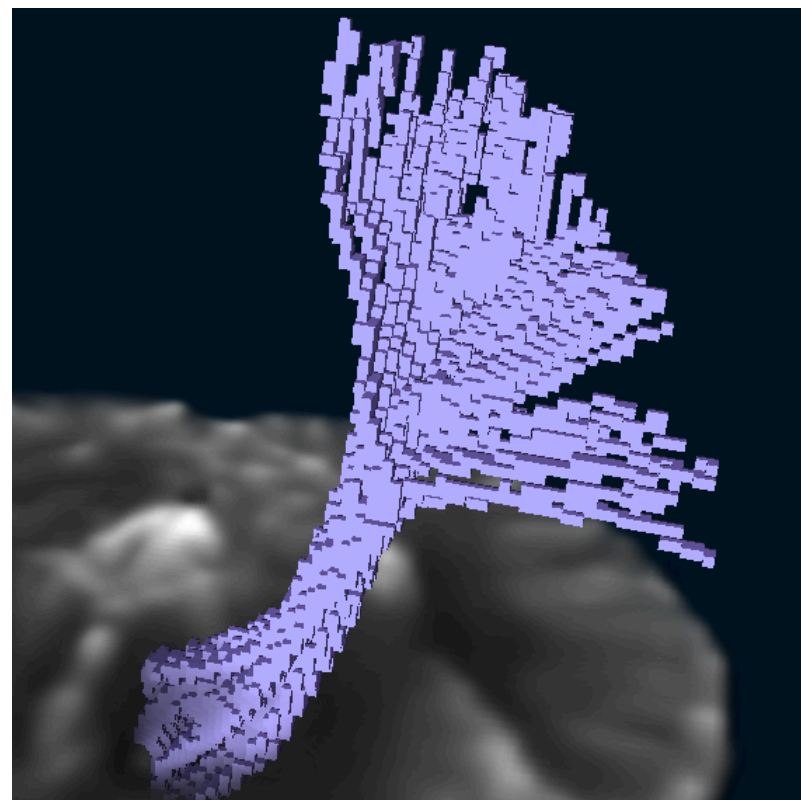# Diffusion Profile Display / ROI Analysis
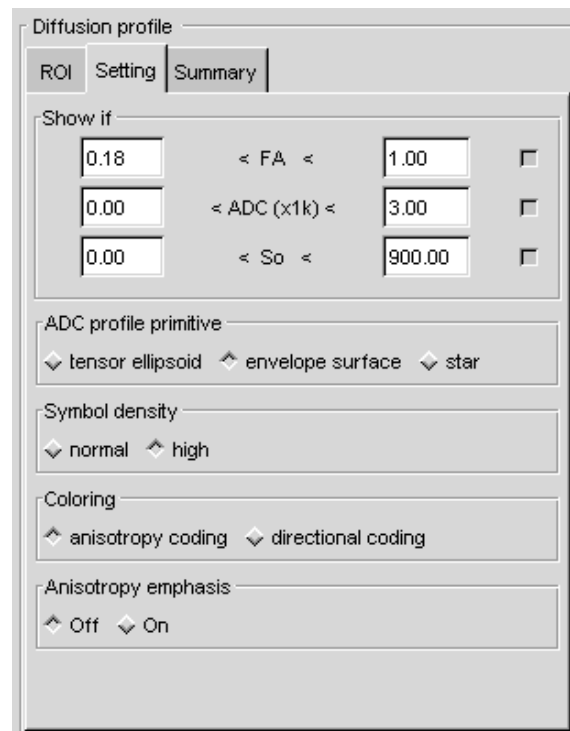
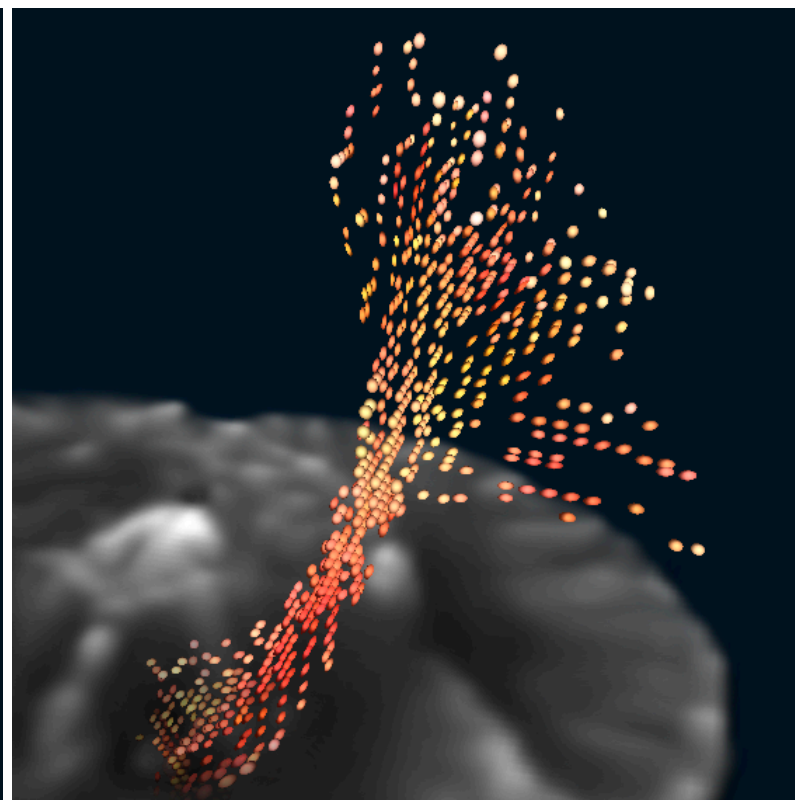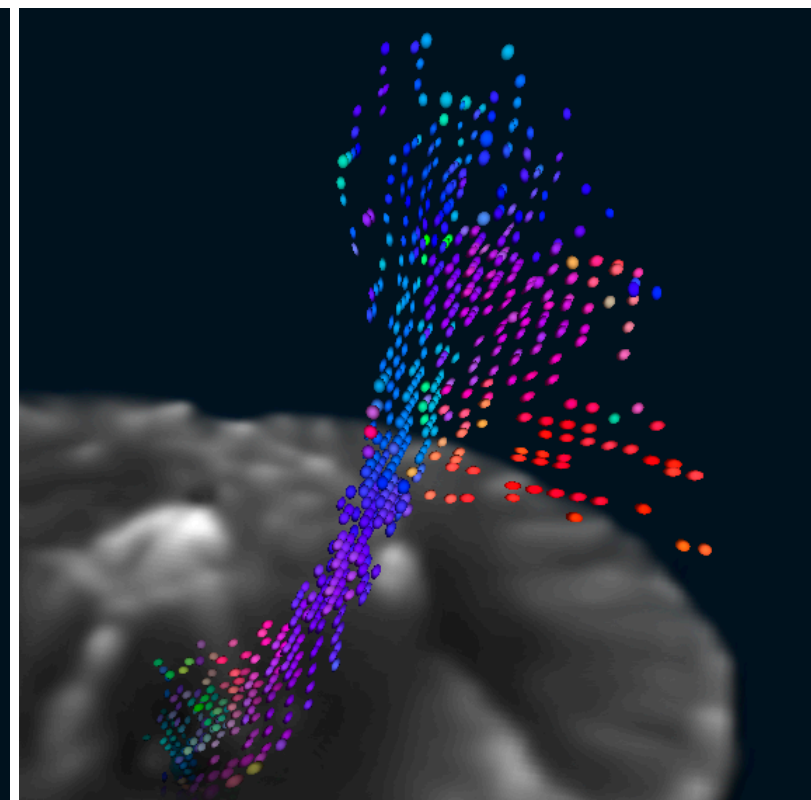settings for profile display
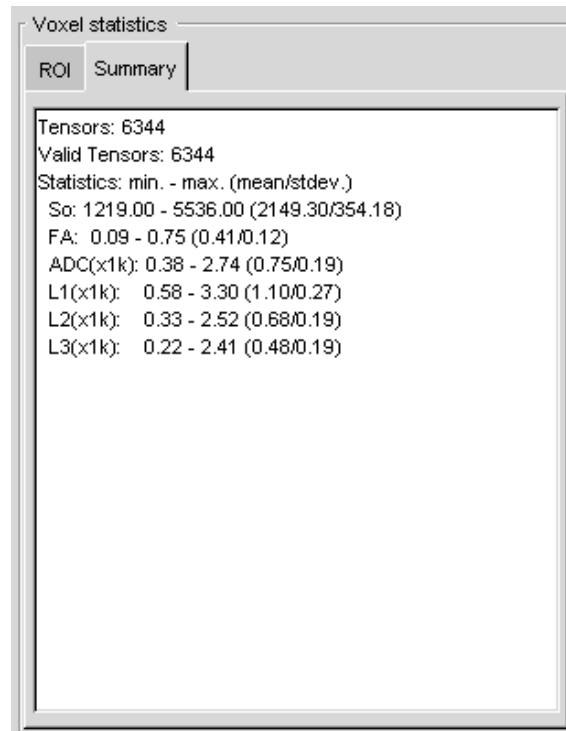
ROI analysis result

- Diffusion Profile with in ROI
  - Primitives
    - Tensor ellipsoids, ADC profiles, Star
  - Coloring
    - Anisotropy or tensor orientation

- Voxel-based statistics inside ROI
  - Tensor eigenvalues, ADC, FA, etc.
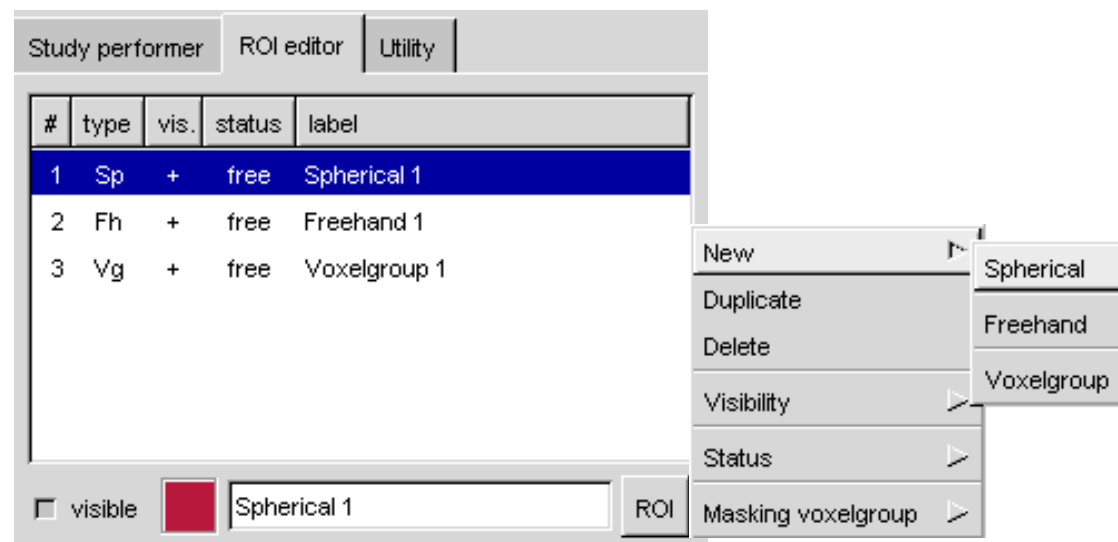

ROI (voxelgroup)
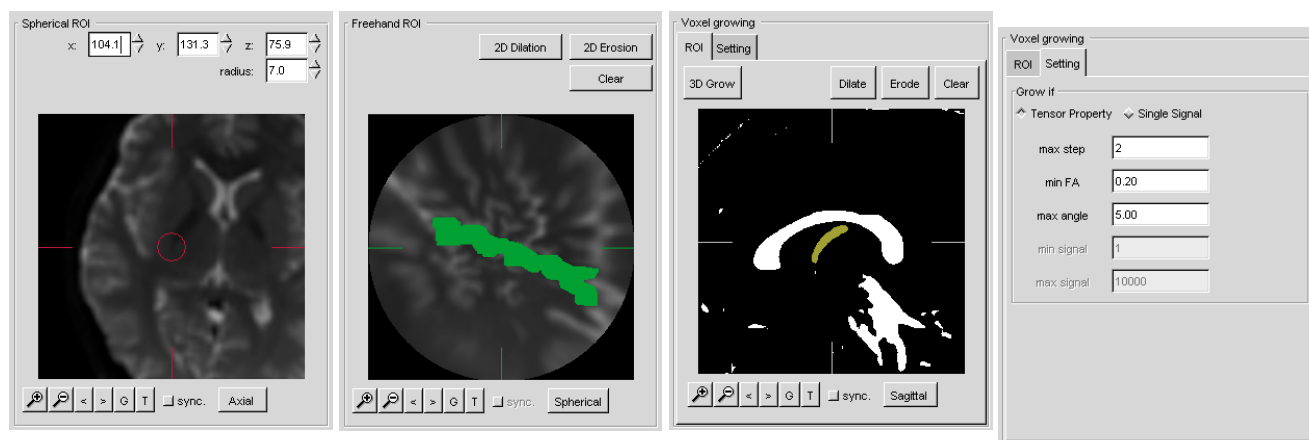

ellipsoids in anisotropy color

ellipsoids in orientation color
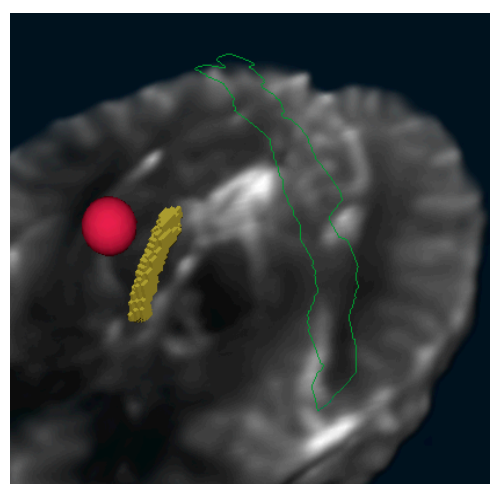
ROI Editor

ROI object list and menu

spherical   freehand   voxelgroup (by region-growing)

Displayed in VOLUME-ONE   Shape processing   (dilated)   (eroded)

- Create, copy, edit and store various types of ROI
  - Sphere
  - Freehand curve
    - on various planes (axial, sagittal, etc.) of several types of images (FA, etc.)
  - Voxelgroup
    - Captured by region-growing
    - ROI shape processing
      - 3D Morphological dilation/erosion
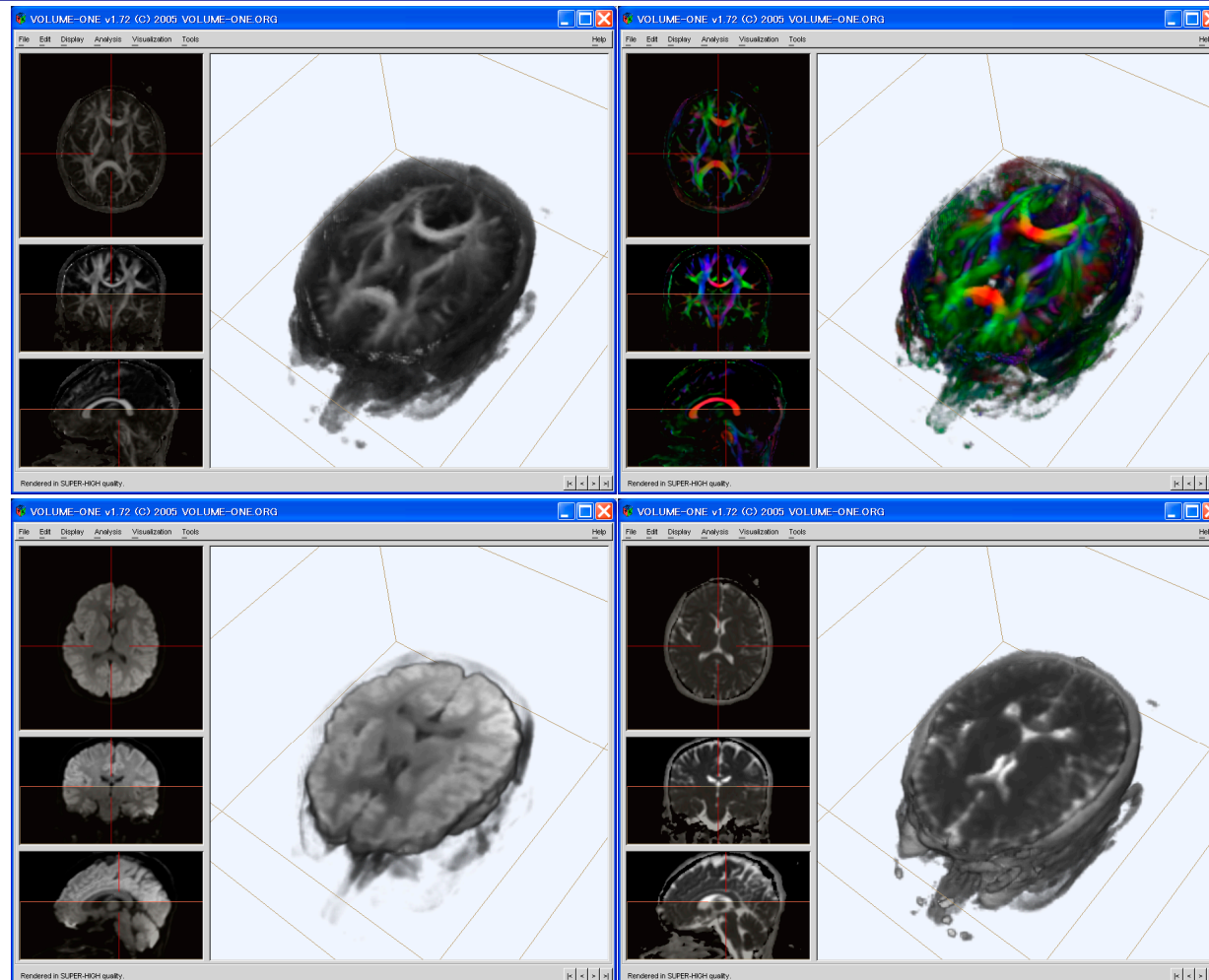
- Displayed in VOLUME-ONE

and more …

Computational images transferred to VOLUME-ONE

- Add computational images and transfer to VOLUME-ONE for 3D display
  - FA, color FA, ADC, and isotropic diffusion
- Fiber tracking result dump as text file
- Fiber trajectory voxelization
  - ROI (voxelgroup) or color/grey volume
- Several time consuming processes were implemented by multi-thread
- Several additional functions only for research (*ex.* SLF canceller)
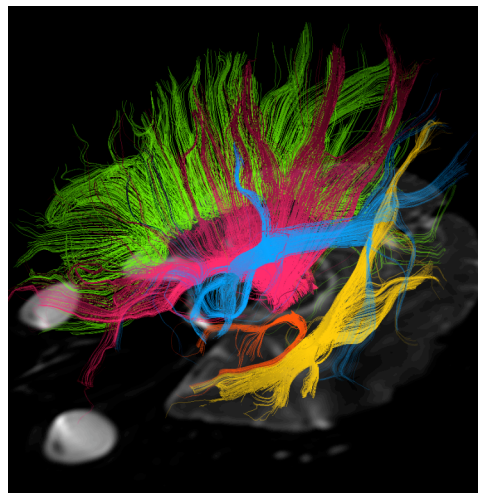 - need to contact with the developer

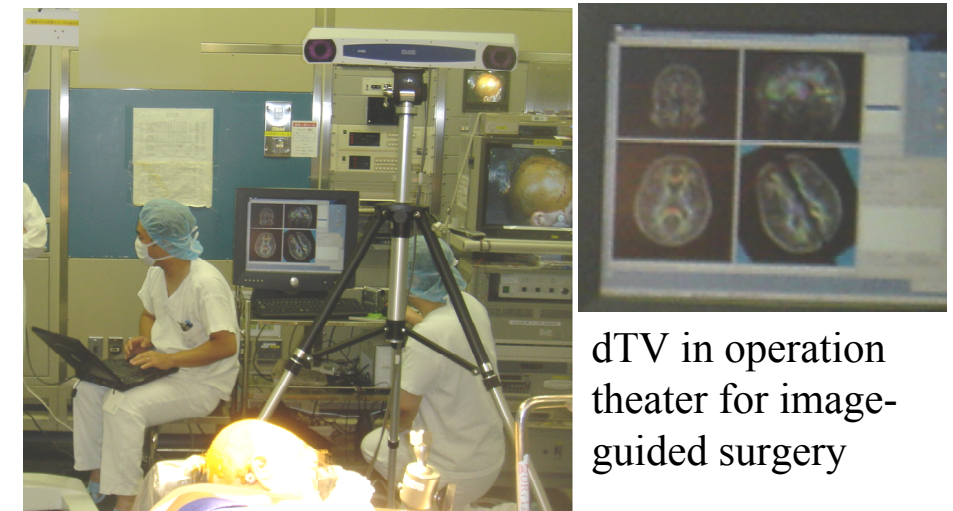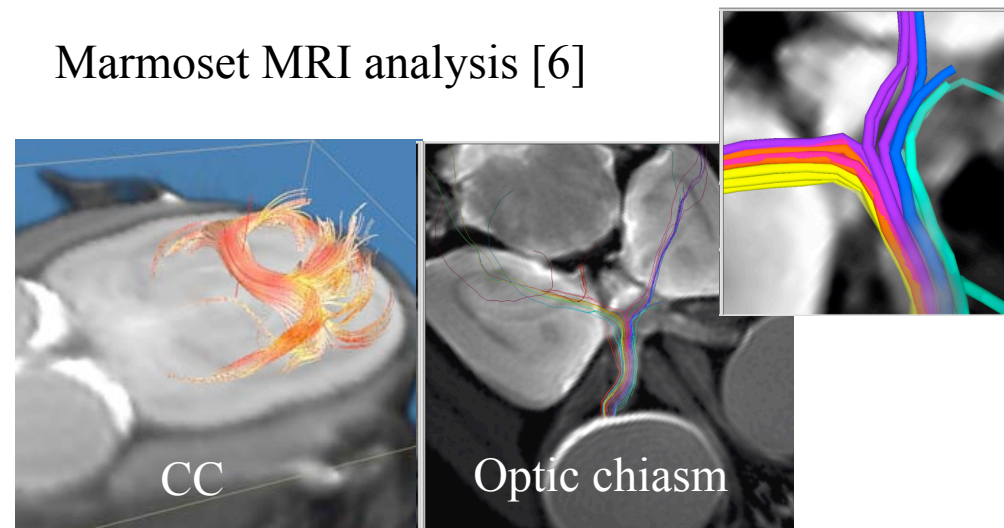dumped fiber tracking result
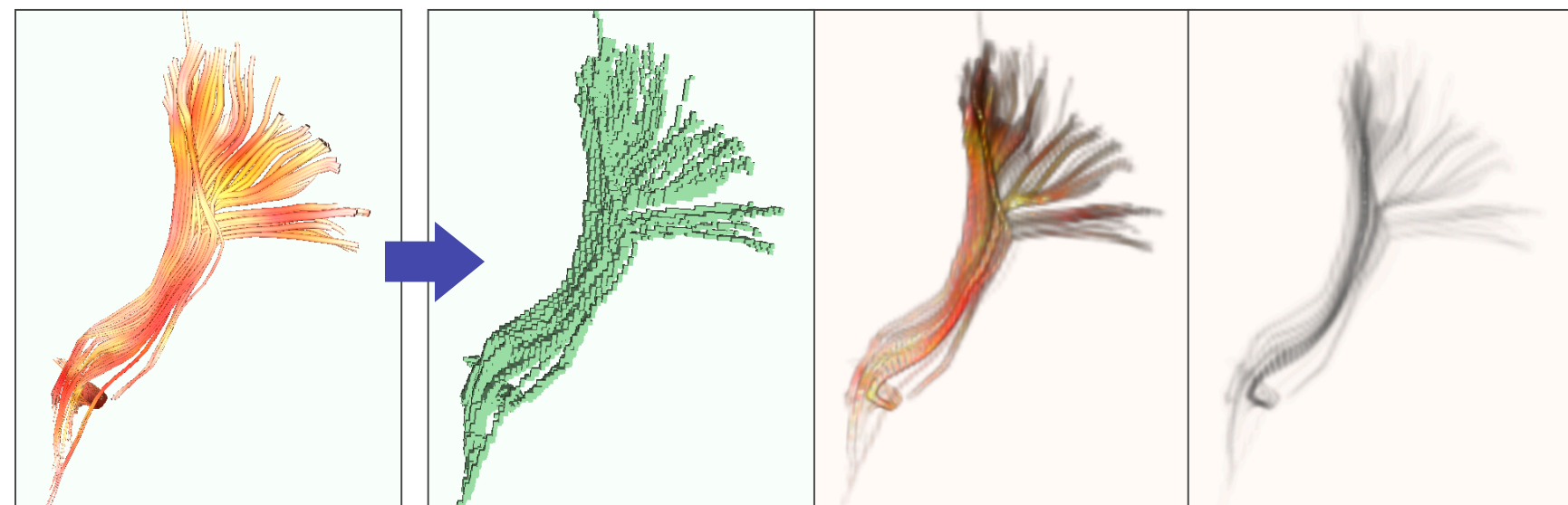
Trajectory voxelization (voxelgroup ROI, color/grey volume)

Gallery

White matter fiber atlas

Marmoset MRI analysis [6]

CC

Optic chiasm
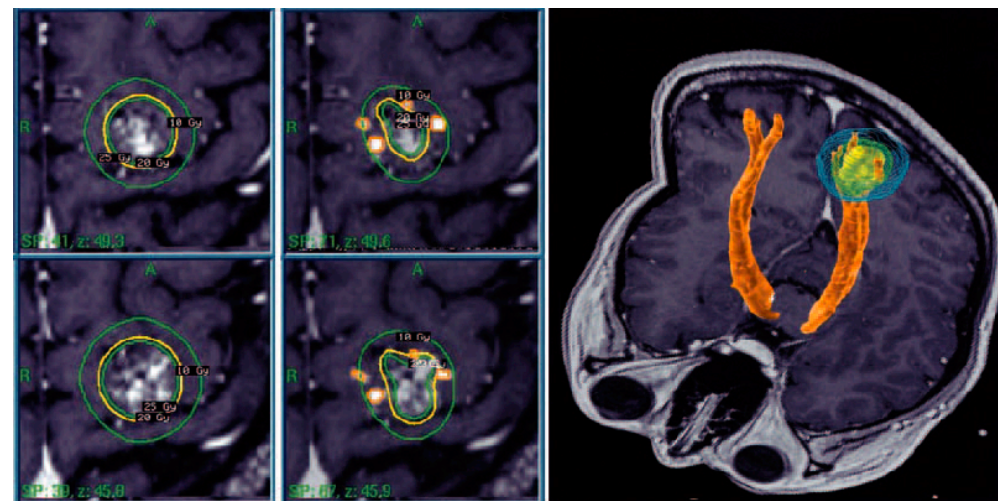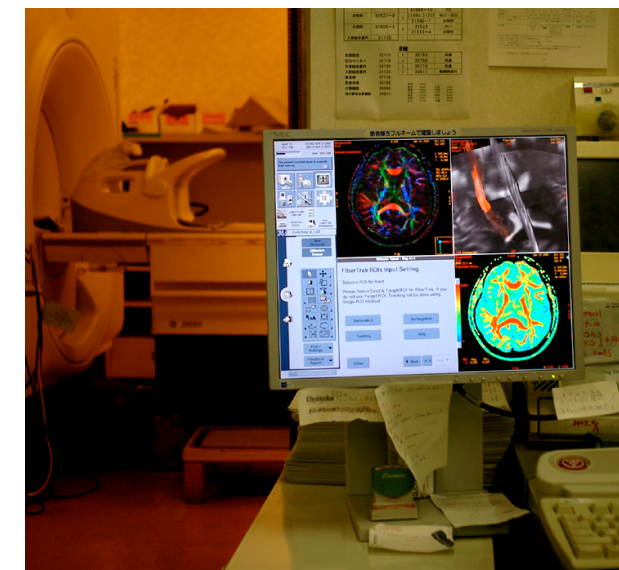

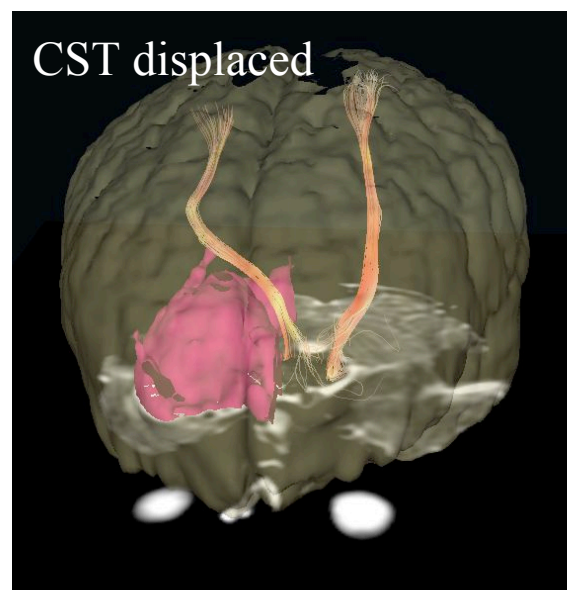dTV in operation theater for image-guided surgery
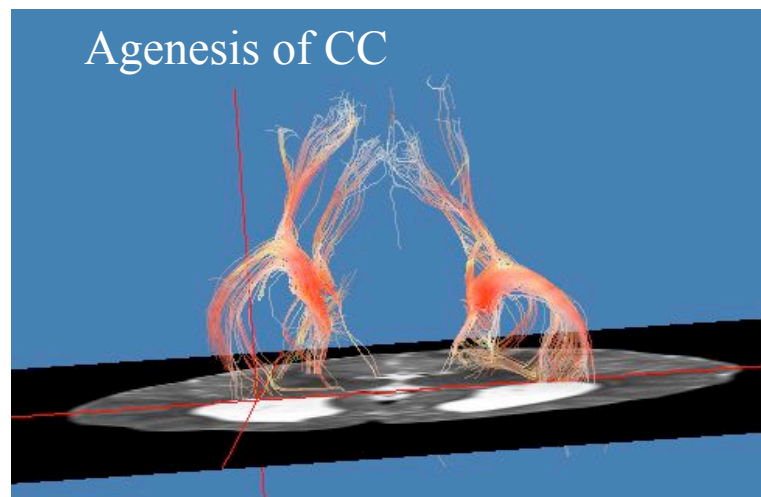
Agenesis of CC
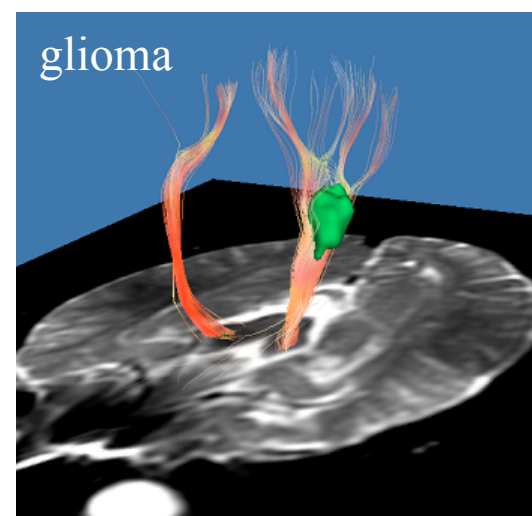

Exported to radiation therapy planning [7,8]

Simplified version of dTV available in GE MR-scanner

CST displaced

glioma

AVM

Anisotropy coloring [2]
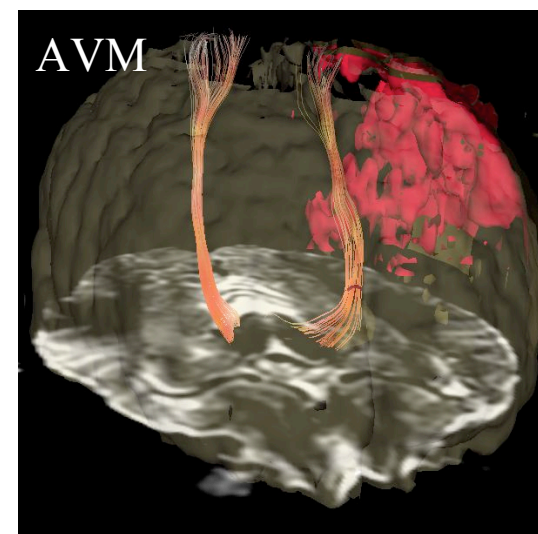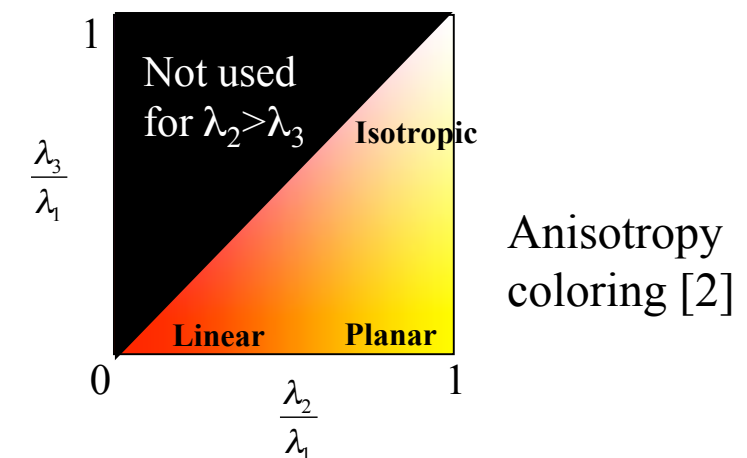
References

VOLUME-ONE and dTV

1. Y. Masutani, Multi-Dimensional Image Data Viewer with Flexible Extension Capability and its Application in Computer-Based Medical Systems, The 21st IEEE International Symposium on Computer-Based Medical Systems, Jyvaskyla, Finland, June, 2008

dTV and its applications

2. Y. Masutani, et al., MR Diffusion Tensor Imaging: Recent Advance and New Techniques for Diffusion Tensor Visualization, European J. of Radiology, vol.46 no.1, :pp 53-66, 2003

Fiber crossing and SLF cancel for pyramical tract tracking

3. Y. Masutani et al., Pyramidal tract tracking based on presegmentation of superior longitudinal fasciculus and tensor field interpolation. In: Proceedings for annual meeting of ISMRM'07 [CD-ROM], Berlin, May 2007

4. Y. Masutani, et al., Clinical Validation of Fiber Tract Modeling based on Tensor Field Interpolation via Symptom-Topography Correlation Test, Computer-Assisted Radiology and Surgery: 22nd International Congress and Exhibition, Barcelona, Spain, June, 2008

5. Kabasawa H, Quantitative diffusion tensor analysis using multiple tensor ellipsoids model and tensor field interpolation at fiber crossing, Acad Radiol. Jan;15(1):84-92, 2008

Marmoset MRI analysis

6. Yamada M, et al., Diffusion-tensor neuronal fiber tractography and manganese-enhanced MR imaging of primate visual pathway in the common marmoset: preliminary results, Radiology 249(3):855-64, 2008

Radiotheray application

7. Maruyama K, et al., Arcuate fasciculus tractography integrated into Gamma Knife surgery, J Neurosurg. 2008 Nov 21. [Epub ahead of print]

8. Maruyama K, et al., Tolerance of pyramidal tract to gamma knife radiosurgery based on diffusion-tensor tractography, Int J Radiat Oncol Biol Phys. 70(5):1330-5, 2008

Other diagnoctic applications

9. Kunimatsu N, et al., Tract-specific analysis of the superior occipitofrontal fasciculus in schizophrenia, Psychiatry Res. 164(3):198-205, 2008

10. Yasmin H, et al., Diffusion abnormalities of the uncinate fasciculus in Alzheimer's disease: diffusion tensor tract-specific analysis using a new method to measure the core of the tract, Neuroradiology 50(4):293-9, 2008

VOLUME-ONE is available at:
http://www.volume-one.org/

dTV is available at:
http://www.ut-radiology.umin.jp/people/masutani/dTV.htm

新版
これでわかる
拡散MRI

Official Book (in Japanese):

S. Aoki, O. Abe, Y. Masutani, et al.,
KORE-DE-WAKARU KAKUSAN-MRI
(you understand diffusion MRI with this)
Oct. 2005, Shu-jun-sha,
ISBN4-87962-293-1

CD-ROM included:
VOLUME-ONE, dTV, and sample data