



3DSlicer  
Version 4.0

# **The 3DSlicer open-source platform for segmentation, registration, quantitative imaging and 3D visualization of biomedical image data**

**Sonia Pujol, Ph.D.**

Brigham and Women's Hospital, Harvard Medical School

Director of Training,  
National Alliance for Medical Image Computing (NA-MIC)  
Neuroimage Analysis Center (NAC)



3D Slicer

A multi-platform, **free and open source** software package for  
**visualization** and **medical image computing**

Download

Tutorial

Feedback

Documentation

## Slicer Wiki

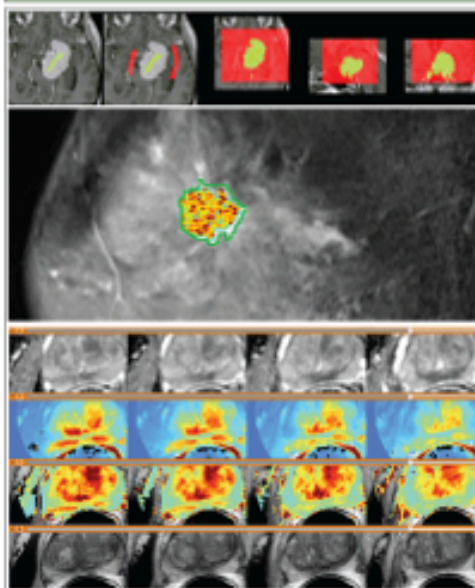
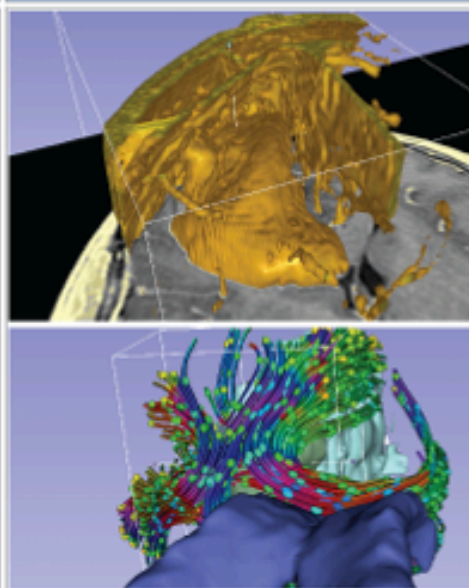
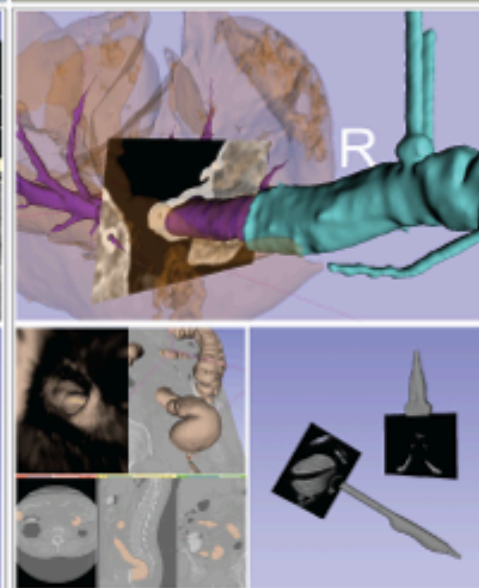
## About Slicer

- Introduction
- Acknowledgments
- Contact Us

## Resources

Download

- For Users
- For Developers
- Commercial Use
- NCIA
- Publication DB
- Image Gallery
- Slicer Community
- Source Code
- Licensing
- Mailing Lists
- Web Archive

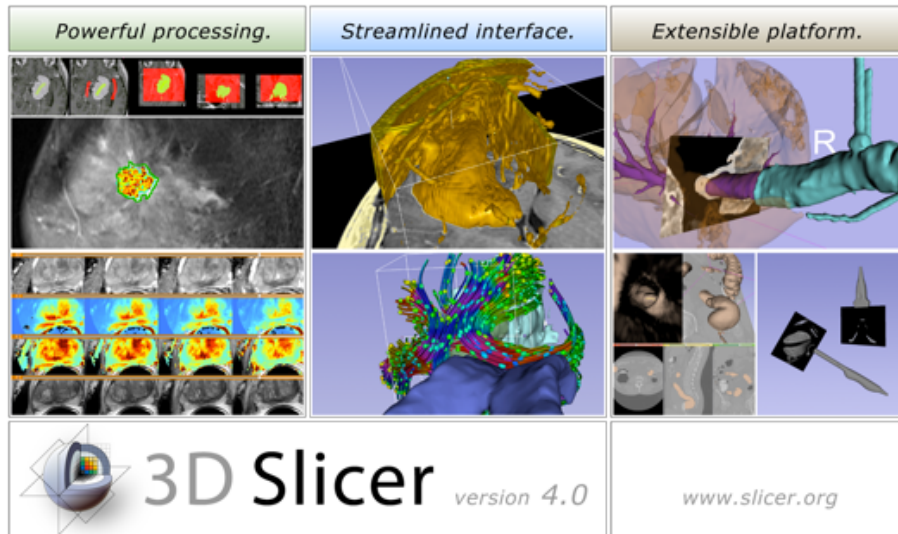
*Powerful processing.**Streamlined interface.**Extensible platform.*3D Slicer *version 4*[www.slicer.org](http://www.slicer.org)

The community of Slicer developers is proud to announce the release of Slicer 4.1. Find out more...



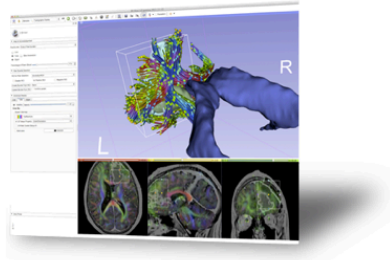
# 3DSlicer

- Slicer is a **freely available open-source** application for viewing, analyzing and interacting with biomedical imaging data





# 3DSlicer



## Get Slicer 4.

Slicer 4 is the latest stable version of 3D Slicer, a free, comprehensive software platform for medical image analysis and visualization developed with NIH support.

3D Slicer is distributed under a permissive [BSD-style open source license](#). It has a thriving user and developer community.

### Pre-compiled binaries

|                |        | Windows  | Mac OS X   | Linux  |
|----------------|--------|--|--|--|
| stable release | 64 bit | 4.1.0 64 bit installer<br>2012-04-11<br>r19886 (159.6MB)   | 4.1.0 64 bit installer<br>2012-04-11<br>r19886 (236.9MB)   | 4.1.0 64 bit archive<br>2012-04-11<br>r19886 (251.5MB)   |
|                | 32 bit | 4.1.0 32 bit installer<br>2012-04-11<br>r19886 (153.3MB)   |  |  |
| nightly build  | 64 bit | nightly 64 bit installer<br>2012-04-29<br>r19953 (160.4MB) | nightly 64 bit installer<br>2012-04-27<br>r19951 (237.4MB) | nightly 64 bit archive<br>2012-04-29<br>r19953 (252.0MB) |
|                | 32 bit | nightly 32 bit installer<br>2012-04-29<br>r19953 (154.0MB) |  |  |

### System requirements

Slicer requires 1GB of RAM absolute minimum, with more highly recommended. Common data sets may require 4GB or more RAM for processing. A fast graphics card or GPU that supports OpenGL is also recommended.

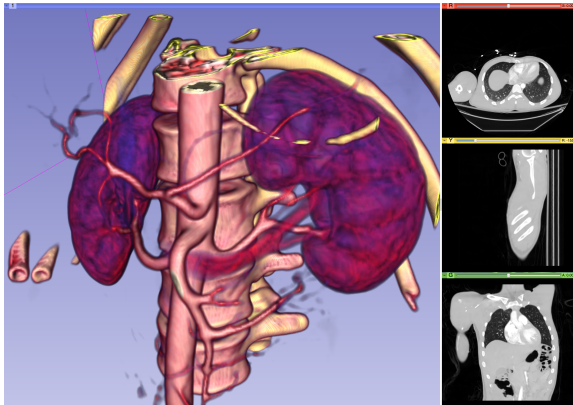
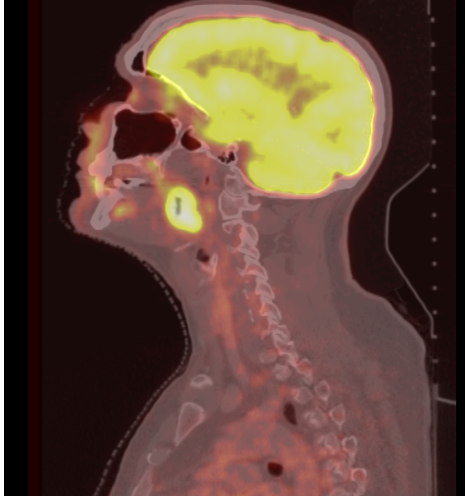
Slicer is built and tested on many hardware and software platforms. 3D Slicer runs on Microsoft Windows XP, Vista, and Windows 7; Mac OS X versions 10.5 (Leopard), 10.6 (Snow Leopard), and 10.7 (Lion); and a variety of Linux distributions.

- Slicer is a **freely available open-source** application for viewing, analyzing and interacting with biomedical imaging data
- Slicer is a **multi-platform** software on Windows, Linux, and Mac





# 3DSlicer



- Slicer is a **freely available open-source** application for viewing, analyzing and interacting with biomedical imaging data
- Slicer is a **multi-platform** software on Windows, Linux, and Mac
- Slicer is a **multi-institutional effort** mainly supported by the National Institute of Health



# Slicer 17<sup>th</sup> year Anniversary

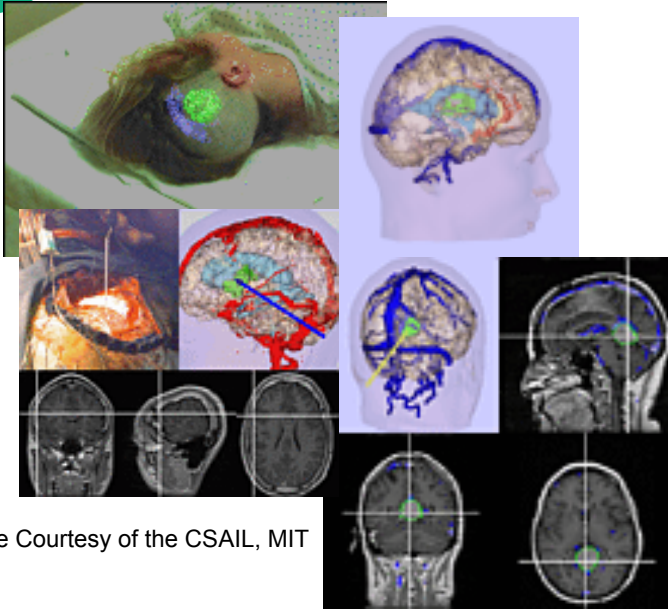
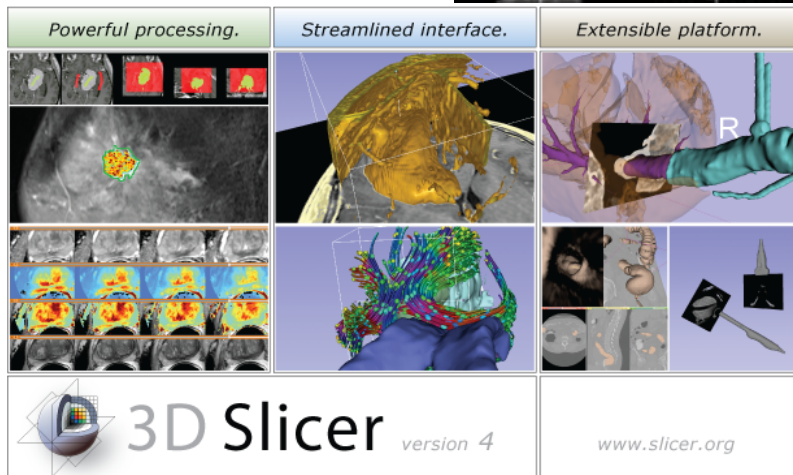


Image Courtesy of the CSAIL, MIT

- 1997: Slicer started as a Master's thesis between the Surgical Planning Lab (Harvard) and the Computer Science and Artificial Intelligence Laboratory (CSAIL) at MIT
- 2014: International open-source platform developed through a multi-institution effort

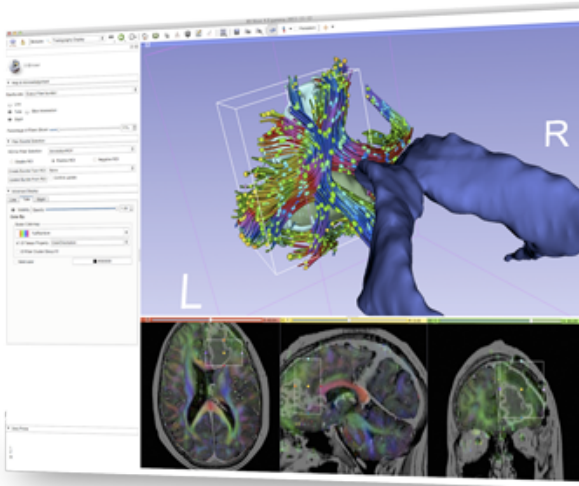


P.I. Prof. Ron Kikinis, BWH, Harvard



# Slicer License

---



- Slicer is distributed under a BSD-style license agreement with no restriction on use
- Slicer is not FDA-approved nor CE-marked
- 3D Slicer bridges the “valley of death” for subject specific analysis

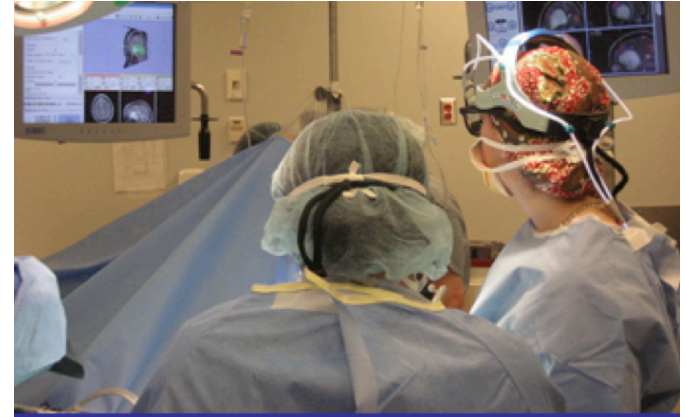


# An interdisciplinary platform

---



An **open-source environment**  
for software developers



An **end-user application**  
for clinical investigators  
and scientists

A software platform that is both **easy  
to use** for clinical researchers and  
**easy to extend** for programmers





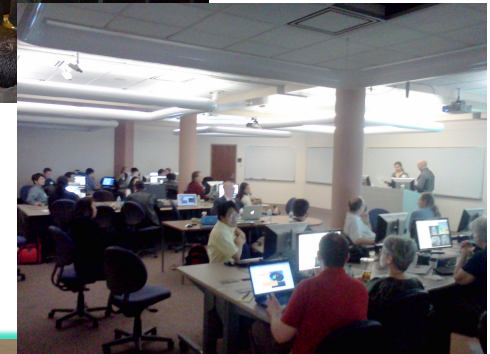
# Slicer Is Open

- Open Science  
=  
Open Source  
+  
Open Data  
+  
Open Community

Madrid 2012



Iowa City, USA 2012

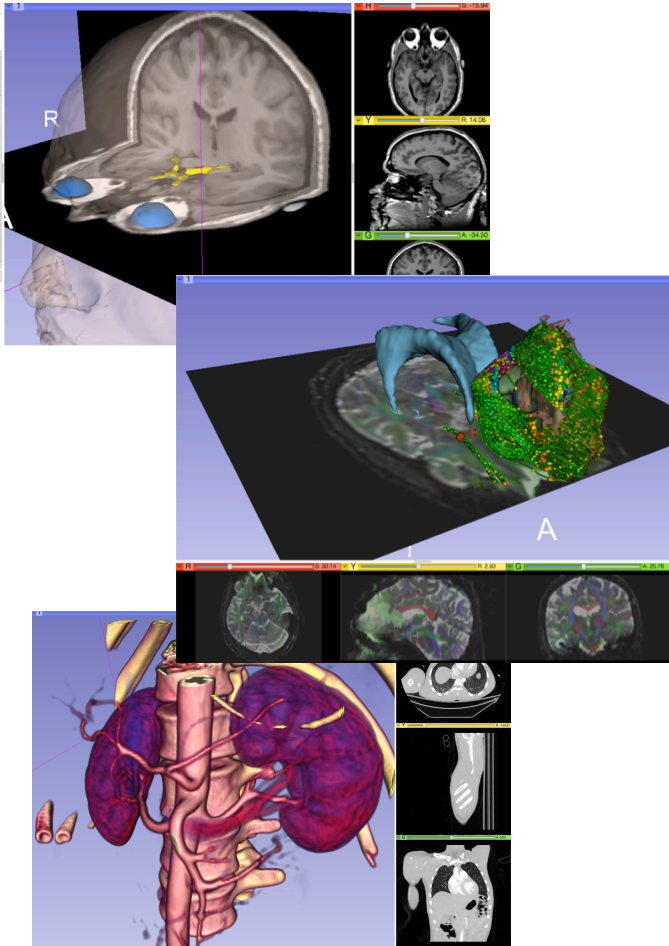


Courtesy R. Kikinis



# Slicer Open Community

---



- 80 authorized developers contributing to the source code
- >700 subscribers on user and developer mailing list
- > 55,000 downloads of Slicer4 since November 2011





# Nov.2011- April 14 Downloads



## Slicer 4 download statistics

Total matching  
downloads:  
**132619**

Date range:

forever

Release type:

any

Browser type:

desktop

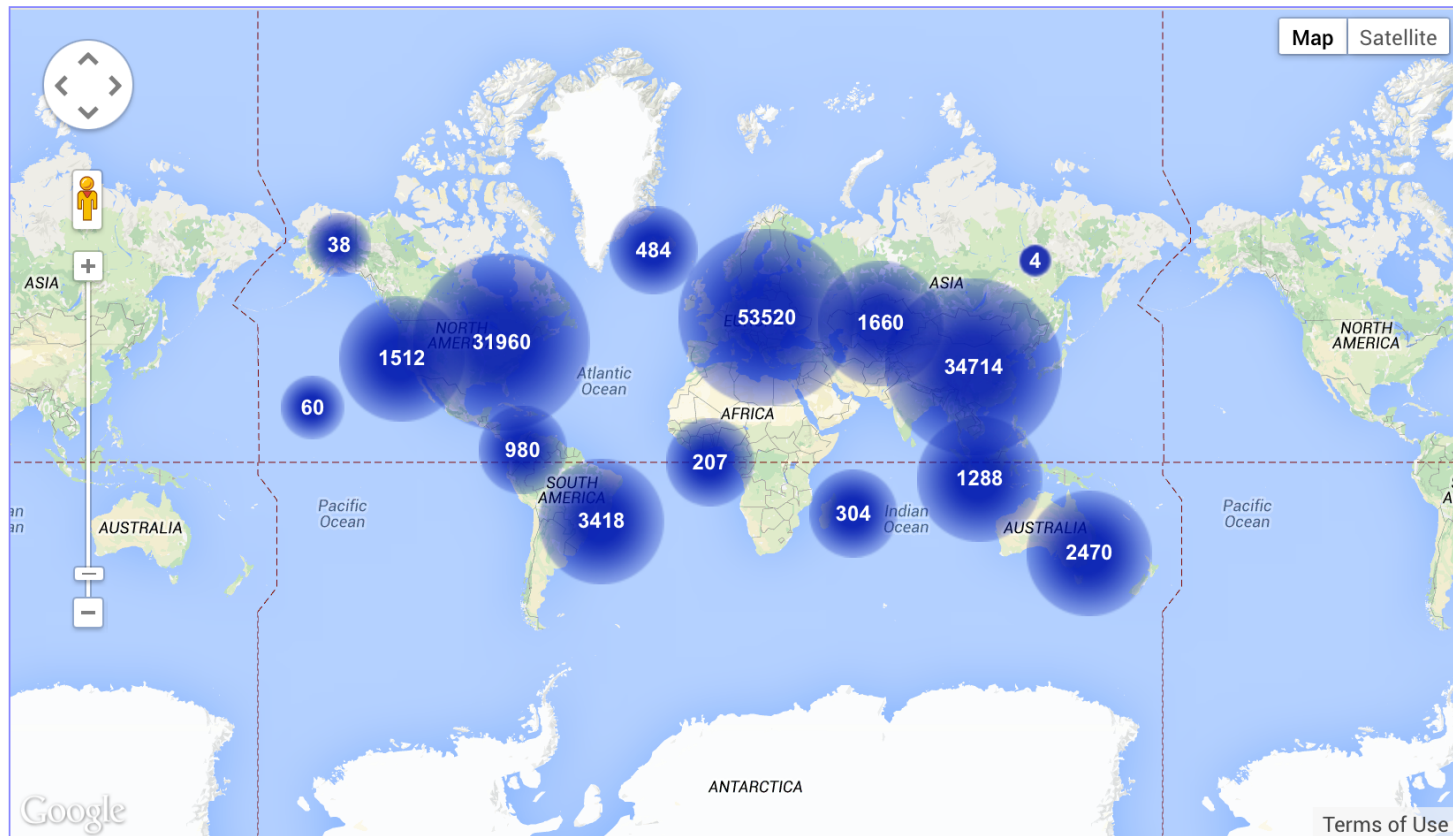
Update

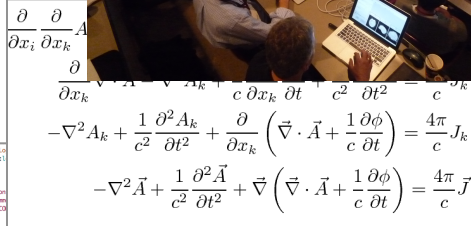
Download location

By Country

By Filename

By Month





# Problem solving

©2012 Surgical Planning Laboratory, ARR




# Slicer is 17 year old

---

- Every 4-5 year: Slicer versions: Major architectural, functional and GUI redesign
- Every 6 month: Within each version, updated release
- Every day!: Binary installation packages to access bleeding-edge functionality



# Slicer is built every night



DashboardCalendarPreviousCurrentProject

WARNING: This CDash instance is running the bleeding edge svn trunk CDash code, and is updated frequently. You have been warned.

2 files changed by 1 author as of Friday, April 27 2012 - 23:00 EDT

Show FiltersAdvanced ViewAuto-refreshHelp

Nightly-Packages

| Site                          | Build Name  | Update | Configure |      | Build |                                    | Test    |                |                   | Build Time  |
|-------------------------------|---|--------|-----------|------|-------|------------------------------------|---------|----------------|-------------------|-------------|
|                               |   | Files  | Error     | Warn | Error | Warn                               | Not Run | Fail           | Pass              |             |
| factory-win7.kitware          | Windows7-VS2008-64bits-QT4.7.4-PythonQt-With-Tcl-CLI-Release 🚩      | 2      | 0         | 0    | 0     | 391 <sup>1190</sup> <sub>198</sub> | 0       | 0              | 556               | 3 hours ago |
| factory-win7.kitware          | Windows7-VS2008-32bits-QT4.7.4-PythonQt-With-Tcl-CLI-Release 🚩      | 2      | 0         | 0    | 0     | 289 <sup>124</sup> <sub>24</sub>   | 0       | 0              | 556               | 5 hours ago |
| factory-ubuntu-64bits.kitware | Linux-g++4.4.3-64bits-QT4.7.4-PythonQt-With-Tcl-CLI-Release 🚩       | 2      | 0         | 0    | 0     | 18 <sup>12</sup> <sub>2</sub>      | 0       | 0 <sub>2</sub> | 558 <sup>12</sup> | 6 hours ago |
| factory-mac-64bits.kitware    | SnowLeopard-g++4.2.1-64bits-QT4.7.4-PythonQt-With-Tcl-CLI-Release 🚩 | 2      | 0         | 0    | 0     | 18 <sup>14</sup> <sub>4</sub>      | 0       | 0              | 558               | 5 hours ago |

Nightly

| Site                          | Build Name  | Update | Configure |      | Build |                                    | Test    |      |      | Build Time  |
|-------------------------------|---|--------|-----------|------|-------|------------------------------------|---------|------|------|-------------|
|                               |   | Files  | Error     | Warn | Error | Warn                               | Not Run | Fail | Pass |             |
| District9.kitware             | Windows-VS2008-QT4.7.4-PythonQt-With-Tcl-CLI-Release                      | 0      | 0         | 0    | 0     | 291 <sup>1190</sup> <sub>190</sub> | 0       | 0    | 555  | 6 hours ago |
| factory-ubuntu-64bits.kitware | Linux-g++4.4.3-64bits-QT4.7.4-PythonQt-With-Tcl-NoCLI-Coverage-Release ⚠️ | 0      | 0         | 0    | 0     | 17 <sup>12</sup> <sub>2</sub>      | 0       | 0    | 356  | 4 hours ago |

Extensions-Nightly

| Site                  | Build Name  | Update | Configure |      | Build |      | Test    |      |      | Build Time  |
|-----------------------|---|--------|-----------|------|-------|------|---------|------|------|-------------|
|                       |   | Files  | Error     | Warn | Error | Warn | Not Run | Fail | Pass |             |
| factory.kitwarein.com | 🍏 19951-LoadableExtensionTemplate-g++64bits-Qt4.7-Release 🚩           |        | 0         | 0    | 0     | 20   | 0       | 0    | 2    | 3 hours ago |
| factory.kitwarein.com | 🍏 19951-SuperBuildLoadableExtensionTemplate-g++64bits-Qt4.7-Release 🚩 |        | 0         | 0    | 0     | 20   | 0       | 0    | 2    | 3 hours ago |
| factory-ubuntu        | 🚩 19951-CLIEExtensionTemplate-g++64bits-Qt4.7-Release 🚩               |        | 0         | 0    | 0     | 0    | 0       | 0    | 1    | 5 hours ago |
| factory.kitwarein.com | 🍏 19951-CLIEExtensionTemplate-g++64bits-Qt4.7-Release 🚩               |        | 0         | 0    | 0     | 0    | 0       | 0    | 1    | 3 hours ago |
| FACTORY-WIN7          | 🚩 19951-CLIEExtensionTemplate-vs9-32bits-Qt4.7-Release 🚩              |        | 0         | 0    | 0     | 0    | 0       | 0    | 1    | 3 hours ago |
| FACTORY-WIN7          | 🚩 19951-CLIEExtensionTemplate-vs9-64bits-Qt4.7-Release 🚩              |        | 0         | 0    | 0     | 0    | 0       | 0    | 1    | 2 hours ago |
| factory-ubuntu        | 🚩 19951-LoadableExtensionTemplate-g++64bits-Qt4.7-Release 🚩           |        | 0         | 0    | 0     | 0    | 0       | 0    | 2    | 5 hours ago |
| FACTORY-WIN7          | 🚩 19951-LoadableExtensionTemplate-vs9-32bits-Qt4.7-Release 🚩          |        | 0         | 0    | 0     | 0    | 0       | 0    | 2    | 3 hours ago |

Slicer is under active development: built every night on every platform




# Slicer Bug Tracker

My View - Mantis

http://www.na-mic.org/Bug/my\_view\_page.php

My View - Mantis



Logged in as: *spujol* (Sonia Pujol - reporter)

2012-04-28 05:35 EDT

Project: Slicer4

Switch

Issue #

Jump

Unassigned [^] (1 - 10 / 29)

0001951

Resample Scalar/Vector/DWI module does not accept DWI input  
Command Line Modules (Modules/CLI) - 2012-04-26 15:09

0001938

Volume rendering volume received from OpenIGTLink  
Base Code - 2012-04-24 16:53

0001930

Scrolling volume slices past the last slice  
Usability - 2012-04-23 19:23

0001929

Texts in 3D are hard to see  
Usability - 2012-04-23 15:36

0001918

Color scale  
Usability - 2012-04-18 11:58

0001915

Effect of matrix bottom row in Transforms module  
Base Code - 2012-04-18 10:12

0001910

Problem with fiducial registration  
Command Line Modules (Modules/CLI) - 2012-04-17 03:11

0001899

Saving and reopening .nrrd problem  
Usability - 2012-04-12 12:43

0001887

sceneview roundtrip problem with LUT and with VR  
MRML - 2012-04-11 22:56

0001888

Ensure Capitalization rule is respected all over Slicer  
GUI - 2012-04-10 10:55

Resolved [^] (1 - 10 / 130)

0001204

Centralize revision/version/name of Slicer  
Packaging - 2012-04-26 18:53

0001167

Fix warning related to SlicerFunctionGenerateExtensionDescription  
Building (CMake, Superbuild) - 2012-04-26 17:24

0001677

SVN download of loadable extension modules does not work  
Base Code - 2012-04-26 16:51

0001747

windows build/run issues as of svn 19350  
Building (CMake, Superbuild) - 2012-04-26 16:06

0001863

To avoid \_RegisterApplication / \_CGSDefaultConnection error, create a template of launchd file for dashboard  
Building (CMake, Superbuild) - 2012-04-26 12:38

0001940

No version in mac bundle  
Packaging - 2012-04-26 10:31

0001645

update of the mouse model toolbar  
GUI - 2012-04-25 16:22

0001593

Untoggle "Place a fiducial" on click  
Annotations - 2012-04-25 16:22

0001936

make RAS box axis labels visibility camera dependent  
Usability - 2012-04-24 11:35

0001923

{{documentation/{{documentation/version}}/module-category}} doesn't support extra newline spacing in XML  
Documentation - 2012-04-23 13:47

Reported by Me [^] (1 - 10 / 37)

0001894

EM Segmenter labelmap opacity  
EMSegmenter - 2012-04-25 20:59

0001389

Tract Visibility  
Diffusion - 2012-04-18 10:27

0001893

Download of Sample MR head data failed  
Base Code - 2012-04-11 16:33

0001845

GUI issue in red slicer viewer mode on Mac  
GUI - 2012-04-11 09:17

0001892

Colors Module GUI: LUT label values issue  
Base Code - 2012-04-10 20:29

0001873

Saving a scene with a new LUT  
Base Code - 2012-04-10 15:23

0001844

Maximum path length - Fiducial seeding  
Diffusion - 2012-04-07 12:23

0001867

Restoring a scene view with tract intersection  
Diffusion - 2012-04-07 12:21

0001866

Saving Scene: path update issue  
Base Code - 2012-04-06 12:06

0001778

Tractography Display module  
Diffusion - 2012-04-06 11:37

Recently Modified [^] (1 - 10 / 776)

0001855

Link errors during CTK build  
Building (CMake, Superbuild) - 2012-04-27 17:03

0001868

crash on exit and other issues  
Scripting (Wrapping, Python) - 2012-04-27 17:00

0001850

Found PythonLibs: ... get\_filename\_component unknown component optimized  
Building (CMake, Superbuild) - 2012-04-27 16:59

0001955

EMSegmenter shows up red in Modules Setting but works fine  
Base Code - 2012-04-27 16:44

0001954

drag & drop: option to lock view settings  
GUI - 2012-04-27 10:04

0001942

Model to Label Map not working  
Diffusion - 2012-04-27 07:46

0001941

Extensions download from SVN repository fails  
Extensions - 2012-04-26 21:52

0001952

camera position after loading scene  
GUI - 2012-04-26 20:13

0001486

VTK Qt designer plugins are missing  
Packaging - 2012-04-26 19:26

0001145

Add Test to make slicer starts  
Base Code - 2012-04-26 19:04



# Interoperability with software package and libraries

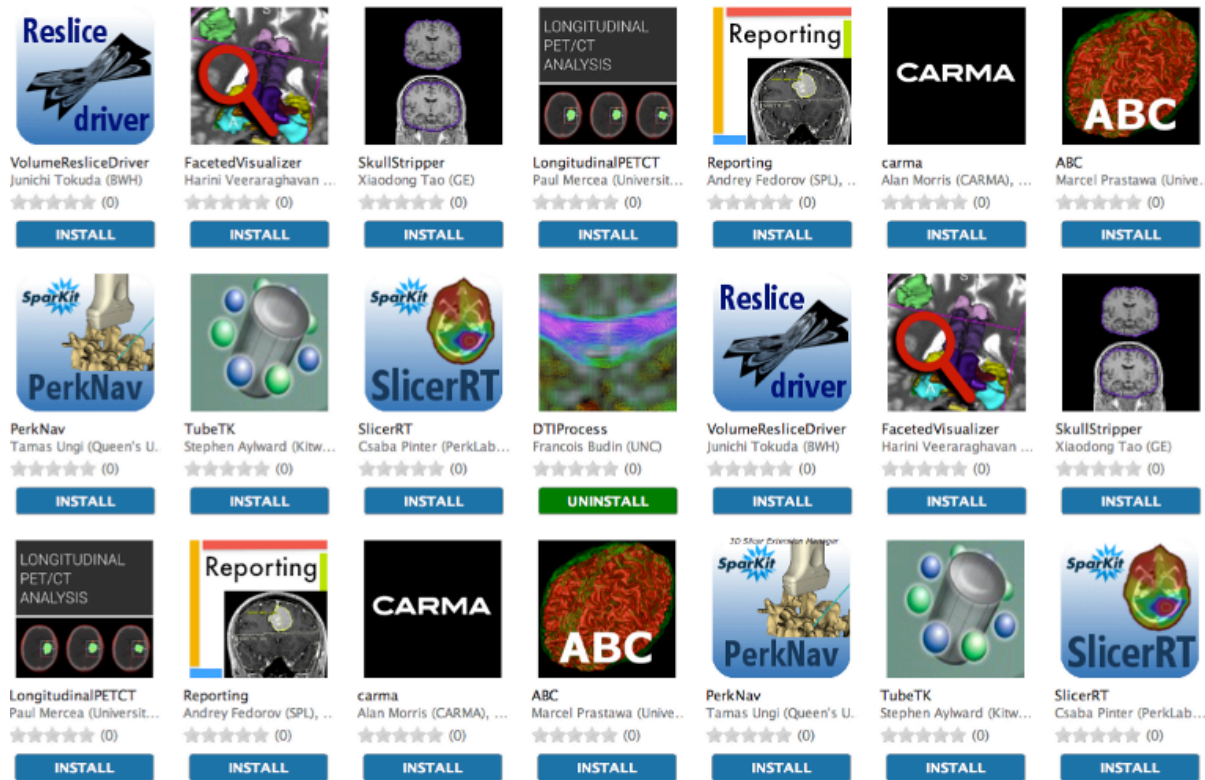
---

- Open-science and open-community philosophy
- File Format compatibility
- Complementary aspects of different open-source software on specialized functionalities



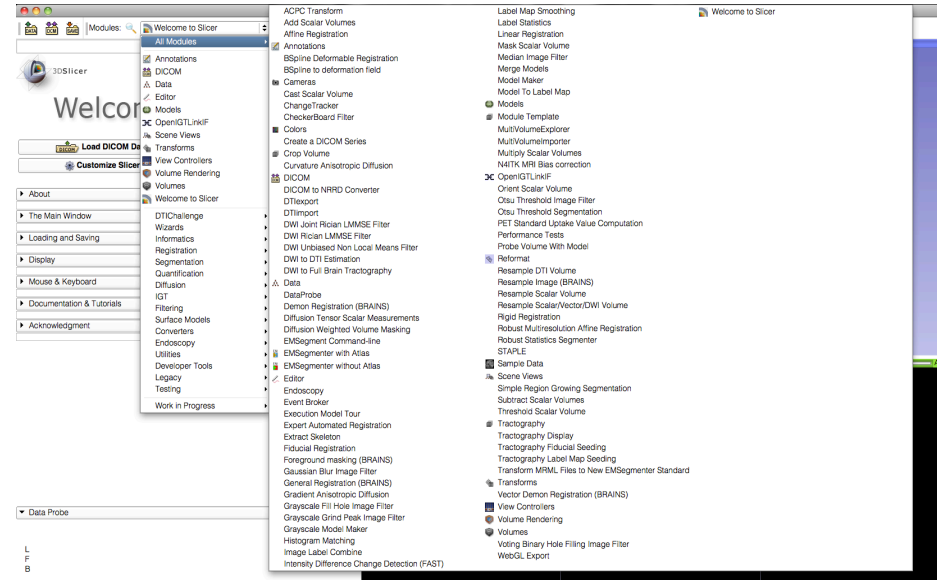


# Slicer Extension Manager



Slicer is Extensible through plugins

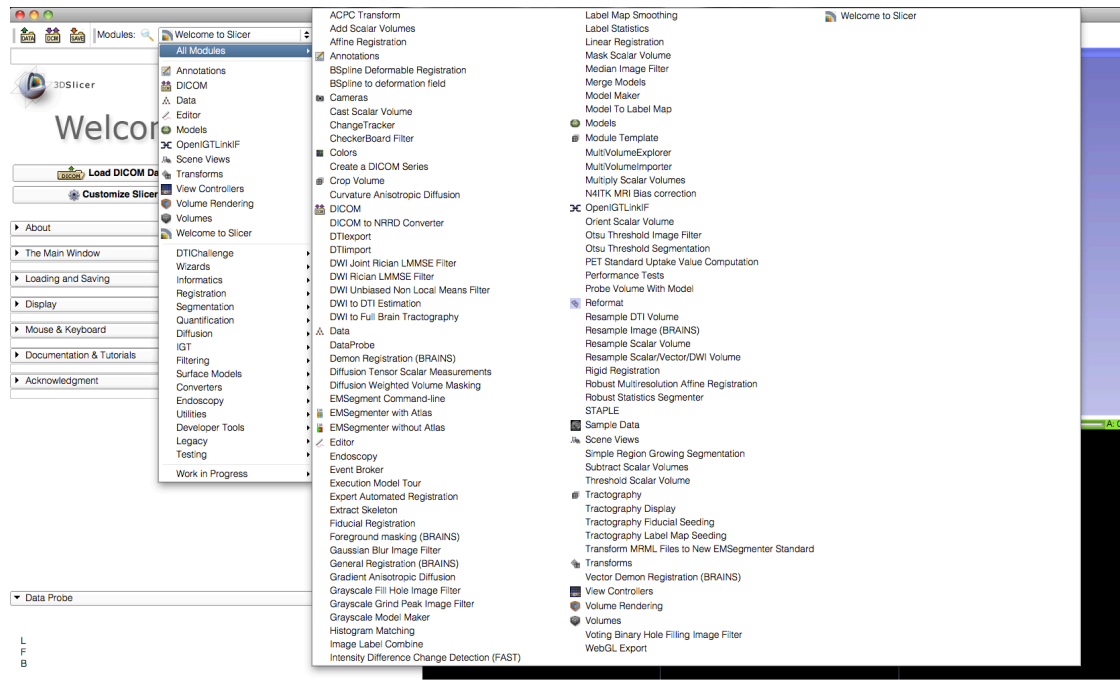
Slicer Extension Catalog offers the possibility to the user to download additional Slicer modules



Slicer4 core functionalities include 108 modules,  
and represent 700,000 lines of code



# Core Functionalities



- Visualization
- Segmentation
- Registration
- Reconstruction
- Diffusion
- Image Guided Therapy
- Quantification
- Reporting



# DICOM module

DICOM Details

Import Export Query Send Remove LocalDatabase /Users/spujol/tmp/slicerDICOM

| Name  | Age | Scan | Date       | Subject ID | Number | Institution |
|---|-----|------|------------|------------|--------|-------------|
| PET Skull to Mid Thigh Plus DCT Chest W Ini |     |      | 2012-06-07 |            |        |             |
| SOFT  | CT  | 3    | 2012-06-07 |            | 1      |             |
| HEAD NECK_2D AC                             | PT  | 401  | 2012-06-07 |            | 0      |             |
| PET SKULL-MID THIGH PL                      |     |      | 2012-11-06 |            |        |             |
| SOFT  | CT  | 3    | 2012-11-06 |            | 1      |             |
| HEAD NECK_2D AC                             | PT  | 5    | 2012-11-06 |            | 0      |             |

SOFT NECK\_

| DICOM Data   | Reader        | Warnings                      |
|--|---------------|-------------------------------|
| <input checked="" type="checkbox"/> 3: SOFT              | Scalar Volume |                               |
| <input checked="" type="checkbox"/> 401: HEAD NECK_2D AC | Scalar Volume |                               |
| <input type="checkbox"/> 3: SOFT for contentTime of 1... | Scalar Volume | Images are not equally spaced |
| <input type="checkbox"/> 3: SOFT for contentTime of 1... | Scalar Volume | Images are not equally spaced |
| <input type="checkbox"/> 3: SOFT for contentTime of 1... | Scalar Volume | Images are not equally spaced |
| <input type="checkbox"/> 3: SOFT for contentTime of 1... | Scalar Volume | Images are not equally spaced |
| <input type="checkbox"/> 3: SOFT for contentTime of 1... | Scalar Volume | Images are not equally spaced |
| <input type="checkbox"/> 3: SOFT for contentTime of 1... | Scalar Volume | Images are not equally spaced |
| <input type="checkbox"/> 3: SOFT for contentTime of 1... | Scalar Volume | Images are not equally spaced |

Uncheck All Load Selection to Slicer Close

☐ Make DICOM Browser Persistent



# DICOM module

The screenshot shows a software window titled 'Form' with two main sections: 'Data Sources' and 'Search Options'.

**Data Sources:**

- Calling AETitle: CTKSTORE
- Servers table:

|   | <input checked="" type="checkbox"/> | Name         | AETitle  | Address        | Port  | CGET                                |
|---|-------------------------------------|--------------|----------|----------------|-------|-------------------------------------|
| 1 | <input type="checkbox"/>            | ExampleH...  | AETITLE  | dicom.exam...  | 11112 | <input type="checkbox"/>            |
| 2 | <input type="checkbox"/>            | MedicalCo... | ANYAE    | dicomserver... | 11112 | <input checked="" type="checkbox"/> |
| 3 | <input checked="" type="checkbox"/> | common       | DCM4CHEE | common.bw...   | 11112 | <input checked="" type="checkbox"/> |

Buttons: Add Server, Remove Server

Storage AETitle: CTKSTORE, Storage Port: 11112

Buttons: Query, Retrieve, Close

**Search Options:**

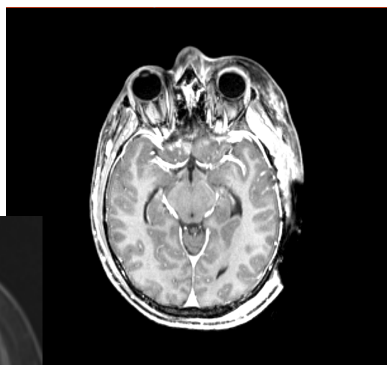
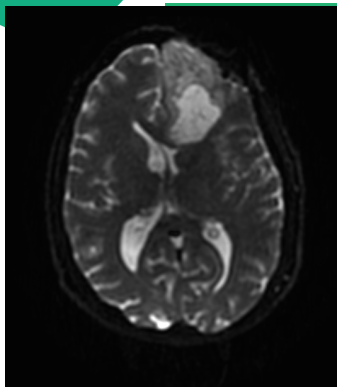
- Tab: Name (selected), Study, Series
- Any Date (selected), Today, Yesterday, Last Week, Last Month, Select Range
- Any (selected), CR, CT, MR, NM, US, PT, XA

- Interface Between DICOM and Slicer

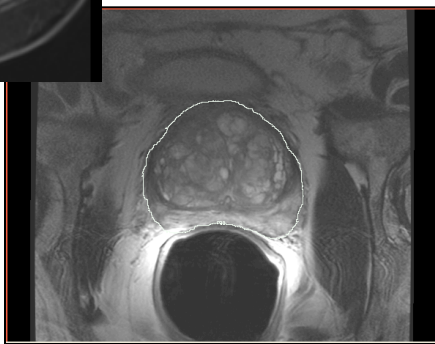
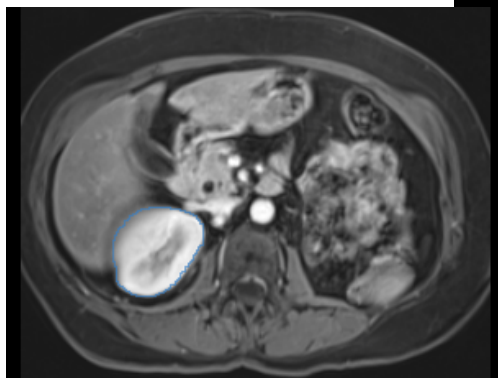
- Core DICOM Parsing in DCMTK/CTK
- Data Pre-Cached in Database
- MRML Manipulation in Slicer Module Logic

- Patient/Study/Series Browser

- Offers Slicer Interpretation of Selected Data
- Multiple Interpretations where DICOM Data is Ambiguous



- Driving Biological Projects leading to the development of new tools
- Applied science oriented toward subject specific analysis in the presence of pathology
- Example: Image-guided therapy







# Slicer use in clinical research environment

---

- AMIGO, BWH, Boston, USA (DTI)
- Slicer RT – Canada

(ECR 2013 IMAGINE Session, ‘SlicerRT – 3D Slicer based open-source toolkit for radiation therapy research’. Pinter et al)

- Quantitative Image Network collaboration with German Cancer Research Institute (PET/CT)

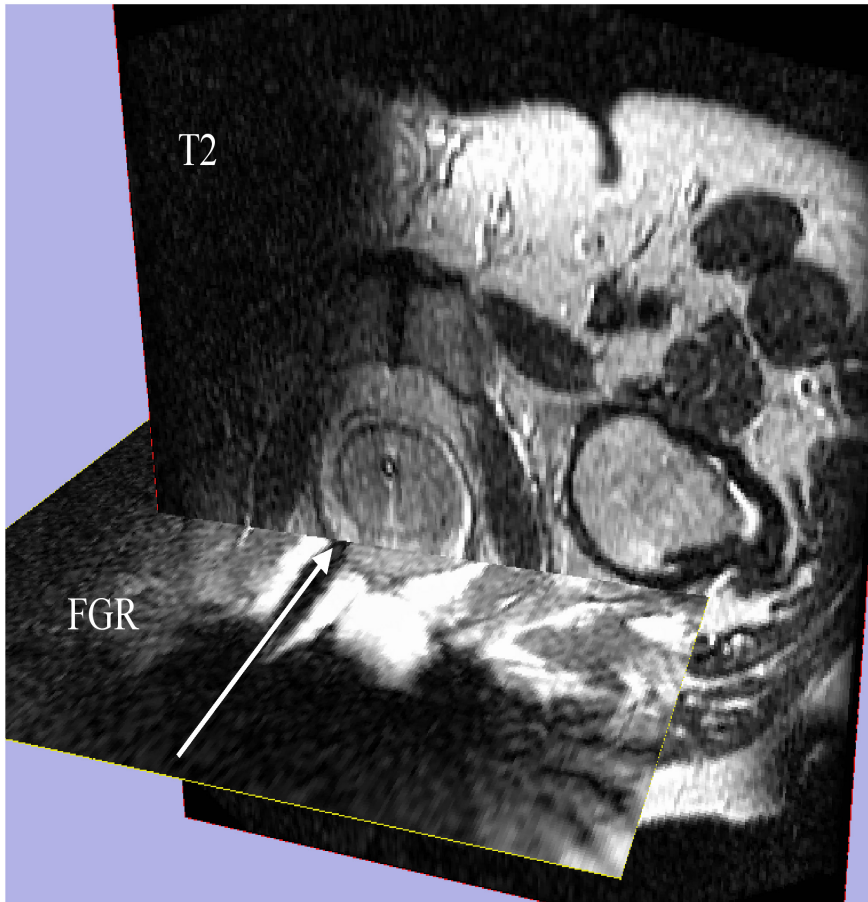


# AMIGO, Brigham and Women's Hospital, Boston, MA

---



Improving Patient Care with AMIGO  
Advanced Multimodality Image Guided Operating Suite



- Image-guided therapy for prostate interventions:
- Brachytherapy Planning
  - Navigation for Biopsy

Haker SJ, Mulkern RV, Roebuck JR, Barnes AS, Dimaio S, Hata N, Tempany CM.: Magnetic resonance-guided prostate interventions. *Top Magn Reson Imaging*. 2005 Oct;16(5):355-68.

Image Courtesy of Steven Haker, PhD and Clare Tempany, MD

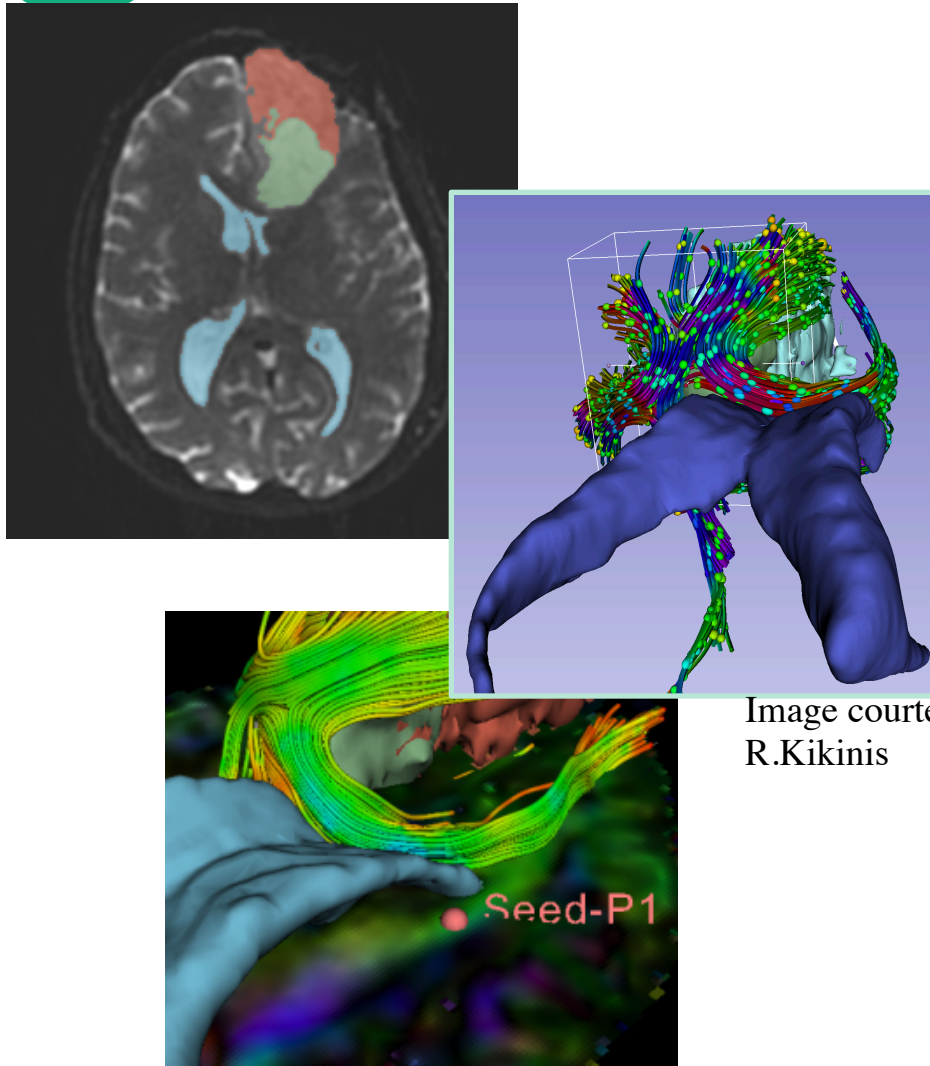


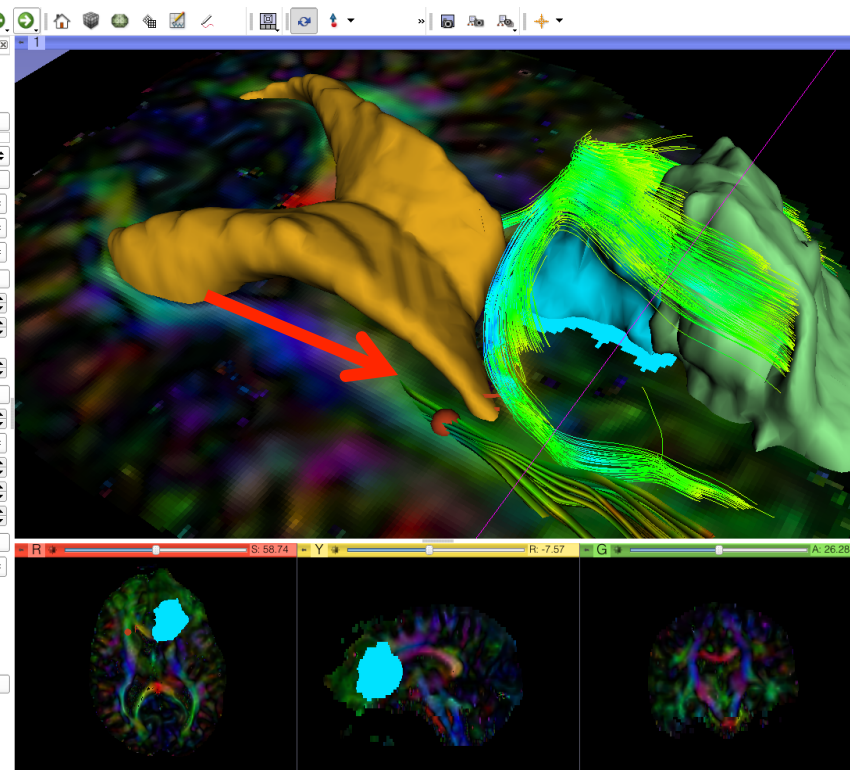
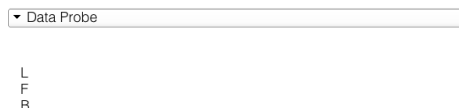
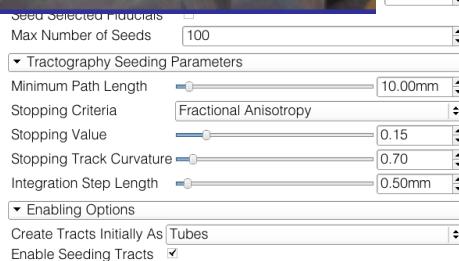
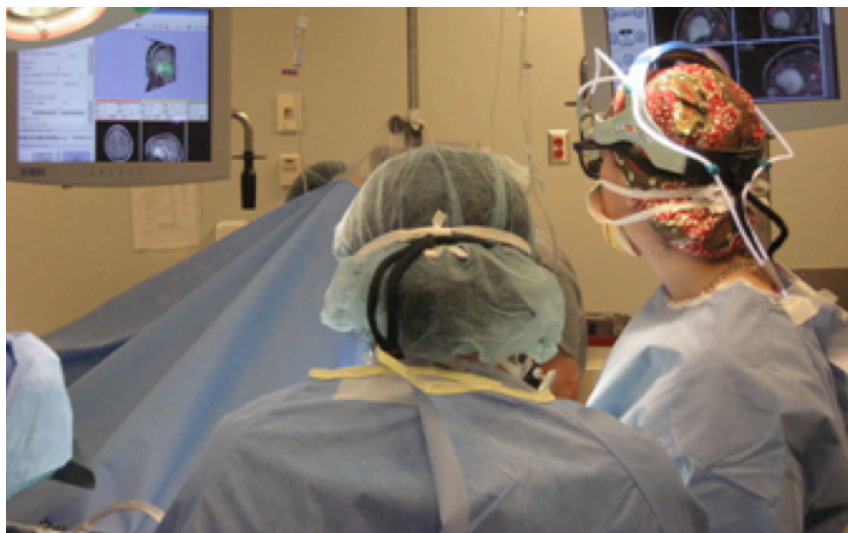
Image courtesy  
R.Kikinis

- Slicer modules used for
- DWI denoising
  - T1/T2/DTI Registration
  - Tumor Segmentation
  - Tractography with Labelmap Seeding
  - Tractography with Fiducial Seeding





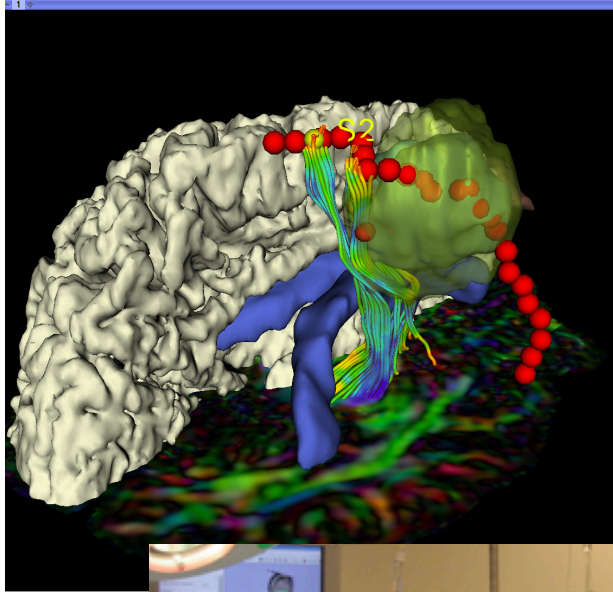
# Fiducial Seeding



Example of on-the-fly exploration of white matter structures in the contralateral side of the tumor

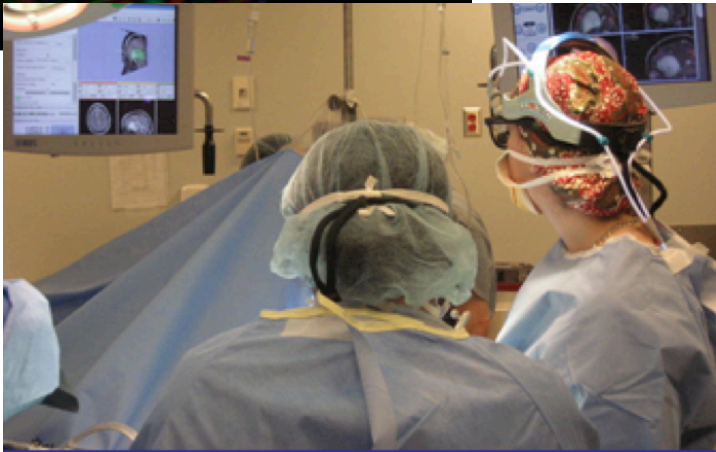


# Tractography for neurosurgical planning



Tractography has the potential to bring valuable information to the neurosurgeon

- Spatial relationship between the tract and the tumor
- Demonstration of tract displacement
- Assessment of tumor infiltration

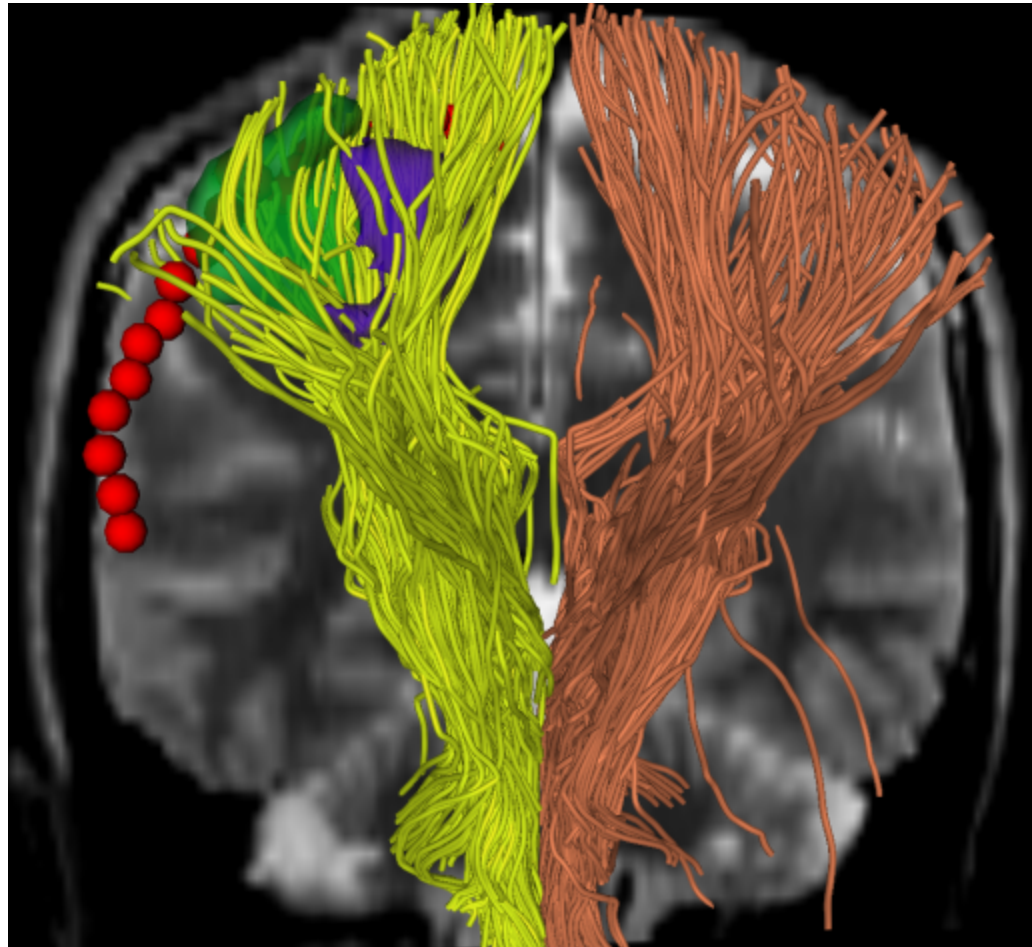






# CST Reconstruction: Method #1

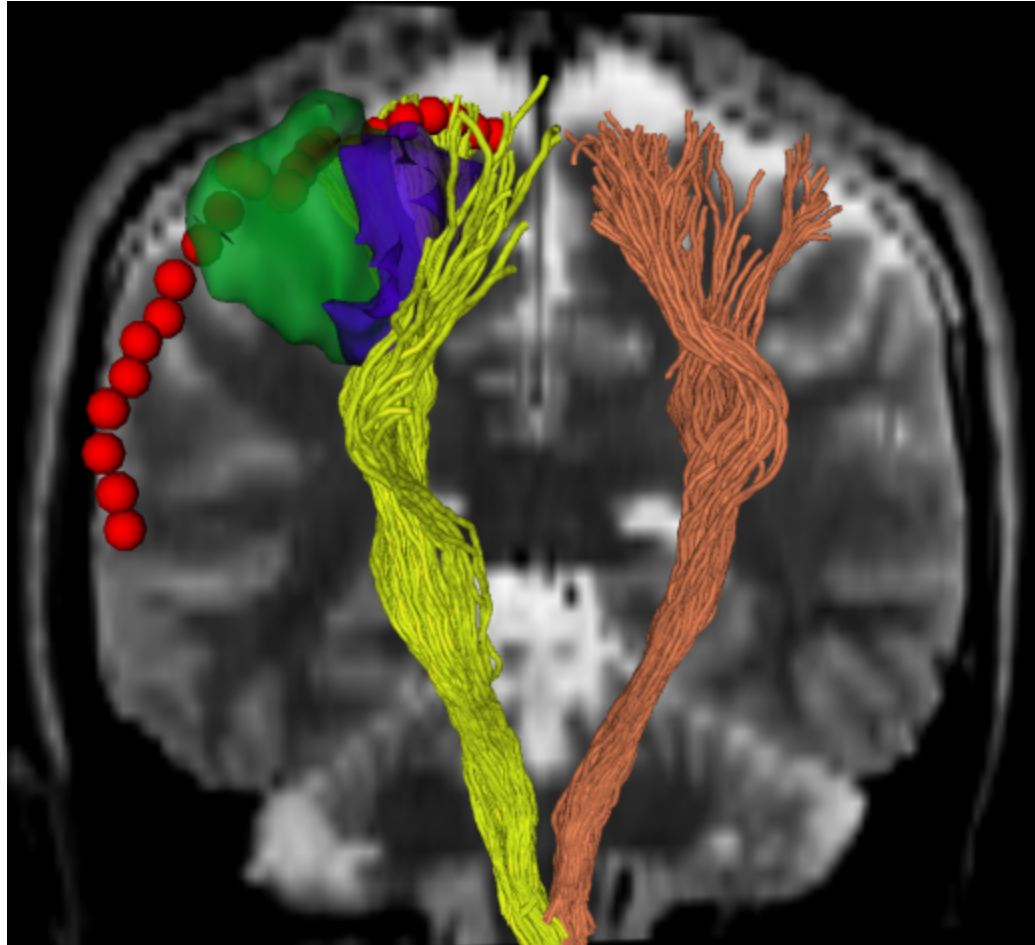
---





# CST Reconstruction: Method #2

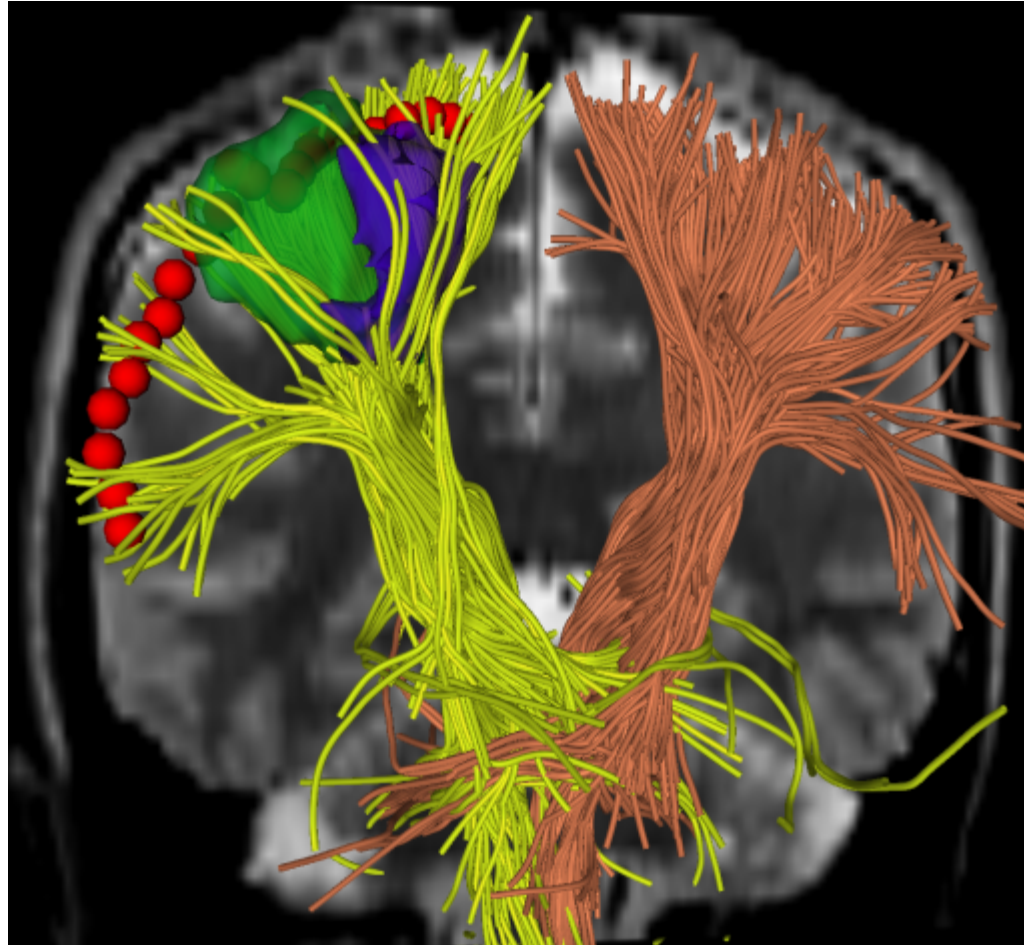
---





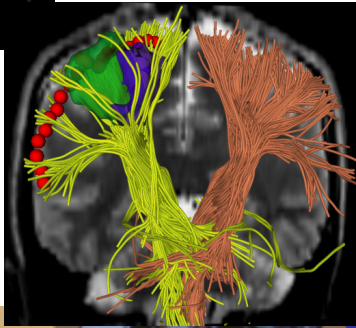
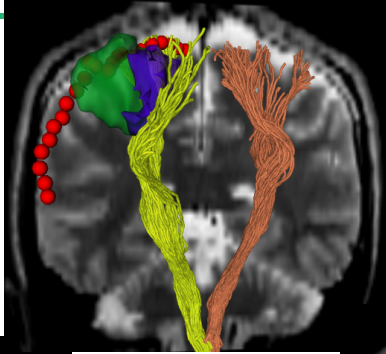
# CST Reconstruction: Method #3

---

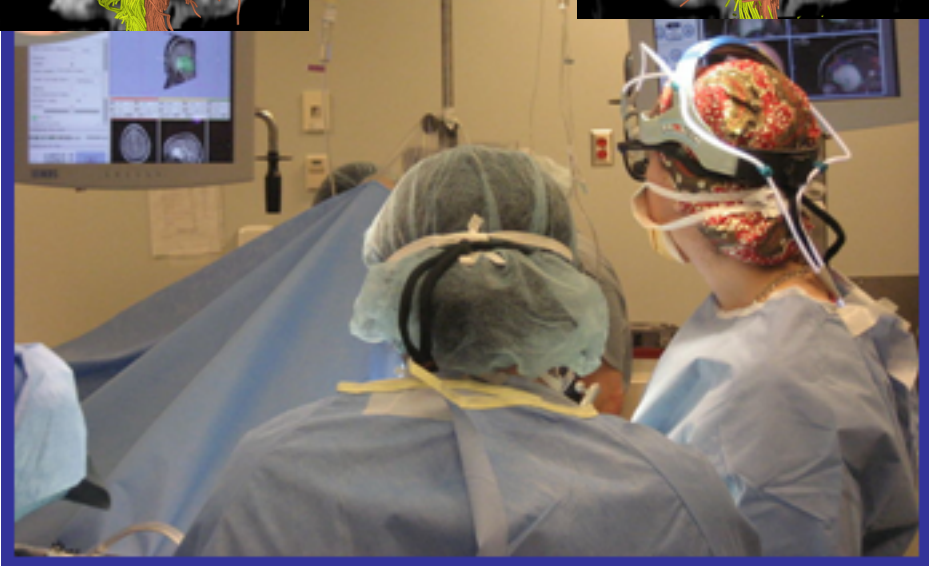




# How to choose ?



Neurosurgeons face the challenge of selecting the appropriate tractography method in the absence of ground truth





# DTI Challenge Project

---



#### Previous Editions

MICCAI 2012 DTI Tractography Challenge, Oct.1st, 2012, Nice, France (2nd Edition)

MICCAI 2011 DTI Tractography Challenge, Sept.18, 2011, Toronto, Canada (First Edition)

Goal:

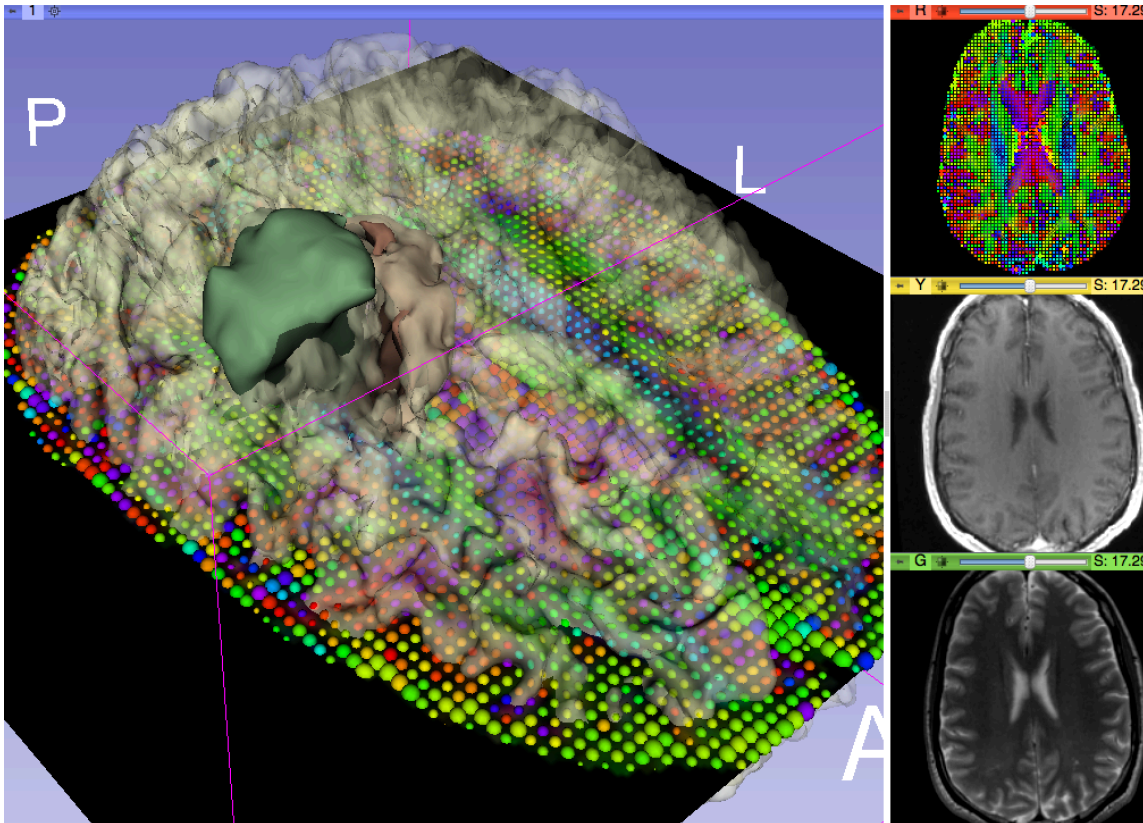
- To define **standards** to evaluate tractography methods for **subject-specific analysis** and ascertain **quality features** for surgical guidance.





# Challenge Datasets

---



- T1, T2, DWI, DTI
- Pre-segmented tumor regions
- 3D White Matter Surface





# DTI Challenge Working Group

---



Working group that brings together medical and technical people:

- **11 practicing neurosurgeons**
- **19 tractography teams**  
(USA, Canada, France, Germany, Japan, China, Spain, Italy, Mexico, Turkey)

Annual DTI Challenge workshop  
at MICCAI conference

# SPL DTI Challenge Working Group (2011-2013)



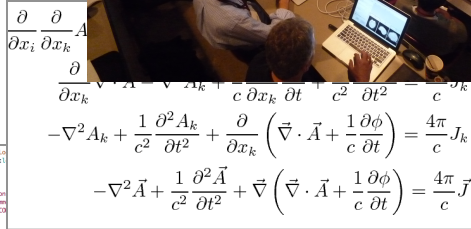
DTI Challenge 3rd Edition  
MICCAI 2013  
Nagoya, Japan



DTI Challenge 2<sup>nd</sup> Edition  
MICCAI 2012  
Nice, France



DTI Challenge 1st Edition  
MICCAI 2011  
Toronto, Canada



# Algorithm Development

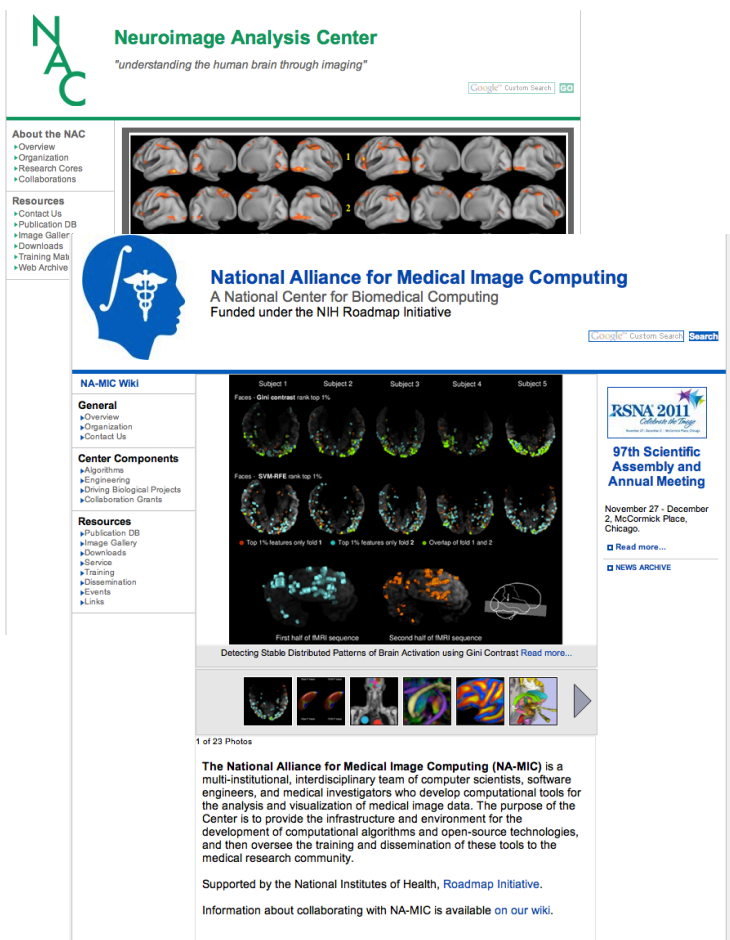
# GAP



# Problem solving



# Slicer Training History: 2005-2013



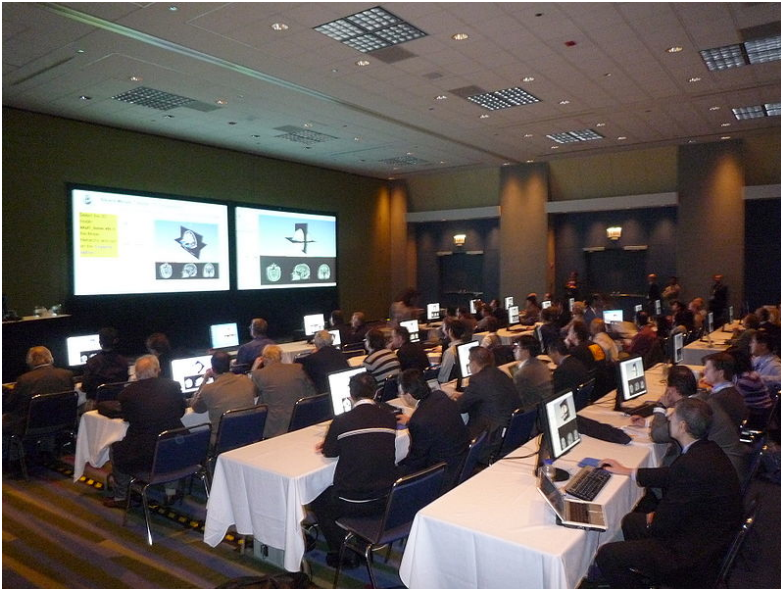
- Training Core Component of two major NIH-funded consortia: the National Alliance for Medical Image Computing (NA-MIC) and the Neuroimage Analysis Center (NAC) (P.I. Ron Kikinis)
- Accelerating the translation of new technology into new skills of scientists and clinical investigators





# Slicer Training Workshops

---



- 1-2 day hands-on events
- Thematic
  - DTI
  - Image-guided therapy
  - 3D Visualization for radiological applications
  - PETCT SUV Computation
- 15-25 all-level participants



# Slicer Training Events

---



Hands-on courses at major international conferences

- **RSNA** 2008, 2009, 2010, 2011, 2012, 2013
- **MICCAI** 2008, 2009, 2010, 2011, 2012, 2013
- **SfN** 2009, 2011
- **SPIE** 2012, 2013
- **CAOS** 2010
- **CARS** 2010, 2012, 2013
- etc...





# Slicer Training Events

---

Invited workshops at international venues:

- PLA General Hospital, Beijing, China,
- Tokyo Women's Medical University, Japan
- IHK Akademie Westerham, Munich, Germany
- Rey Juan Carlos Universidad, Spain



Tokyo, 2010



Munich, 2008



Beijing, 2010



# Project Weeks

---

- Bi-annual week of hands-on programming
- Practical exchange of idea and experience
- 2010: 126 international attendees, 71 projects, 8 countries (Austria, England, France, Germany, Italy, Japan)
- 19 project weeks in the US since 2005





# Conclusion

---

- Slicer is an open-source research platform for the rapid development of biomedical image analysis tools.
- Slicer community is open community with contributors from all over the world
- Slicer is a versatile platform for translational research and subject specific analysis of biomedical image data





# Acknowledgments

---

National Alliance for Medical Image Computing  
NIH U54EB005149

Neuroimage Analysis Center  
NIH P41RR013218