



# Slicer3 and the NA-MIC kit



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# The NA-MIC Kit

**3D Slicer**



**VTK**



**ITK**



**Nrrd**



**KWWidgets**



**CMake**



**CTest**



**Dart**



**Batch Make XNAT**





# 3D Slicer

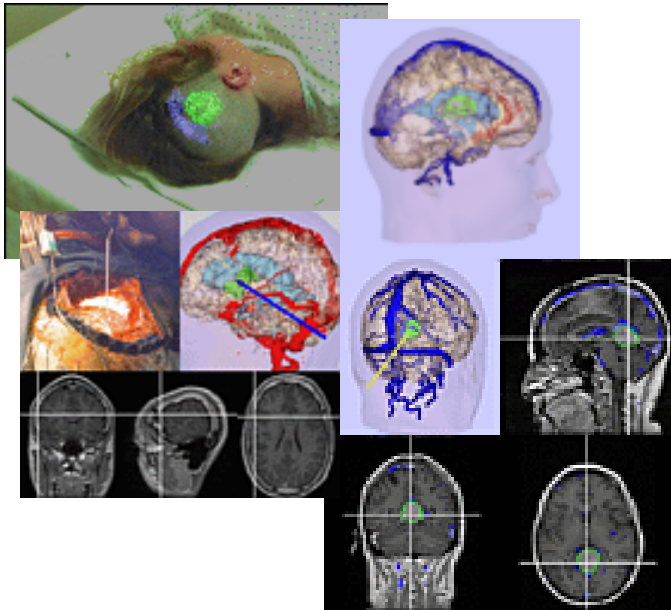
- Open-source application available for Windows, Linux and Mac
- More than 2.8 million lines of code
- Neuroscience and Image-Guided Therapy





# 3D Slicer History

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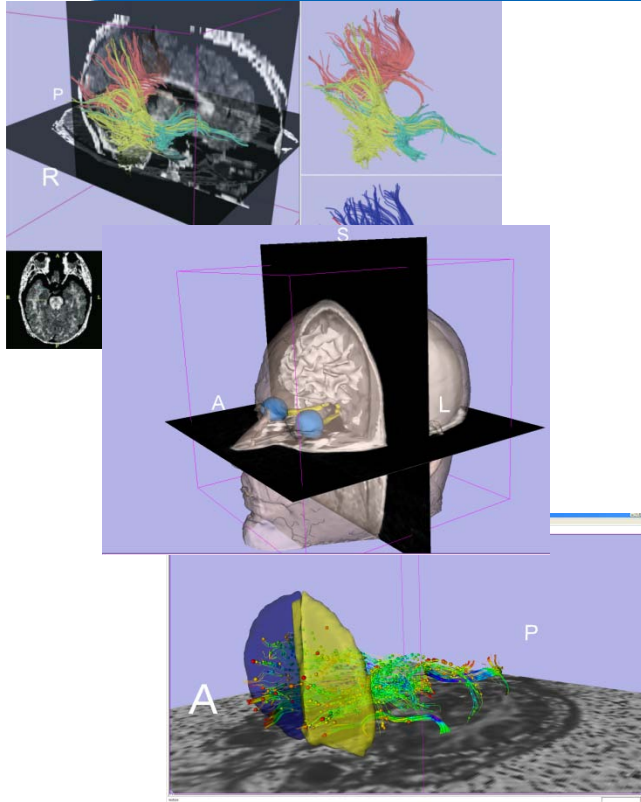


- Started in 1997 between the Surgical Planning Lab (Harvard) and the CSAIL (MIT)

Image Courtesy of the CSAIL, MIT



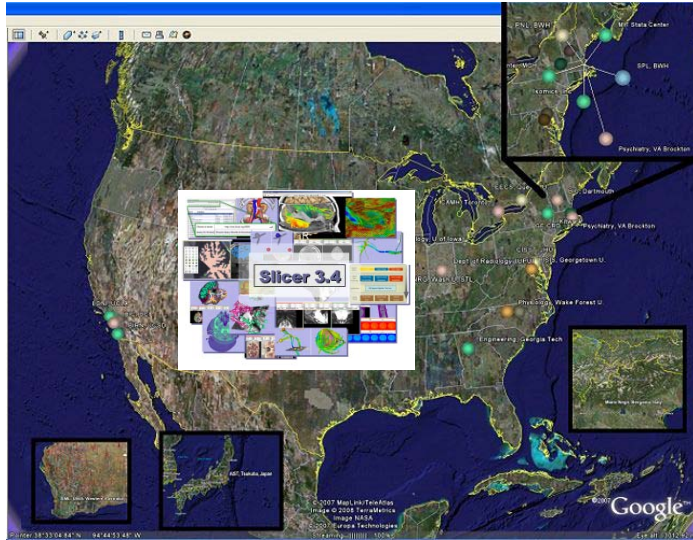
# 3D Slicer History



- Started in 1997 between the Surgical Planning Lab (Harvard) and the (CSAIL) MIT
- 2009: Multi-institution effort to share the latest advances in image analysis with clinicians and scientists



# 3D Slicer Geography



- **Open-source** platform developed on a national scale
  - Supported by the **National Institutes of Health** consortia which include
    - National Alliance for Medical Image Computing
    - Neuroimage Analysis Center
- P.I. Prof. Ron Kikinis, MD,  
Director of the Surgical Planning Lab



NA-MIC

*National Alliance for Medical Image Computing*

*<http://na-mic.org>*

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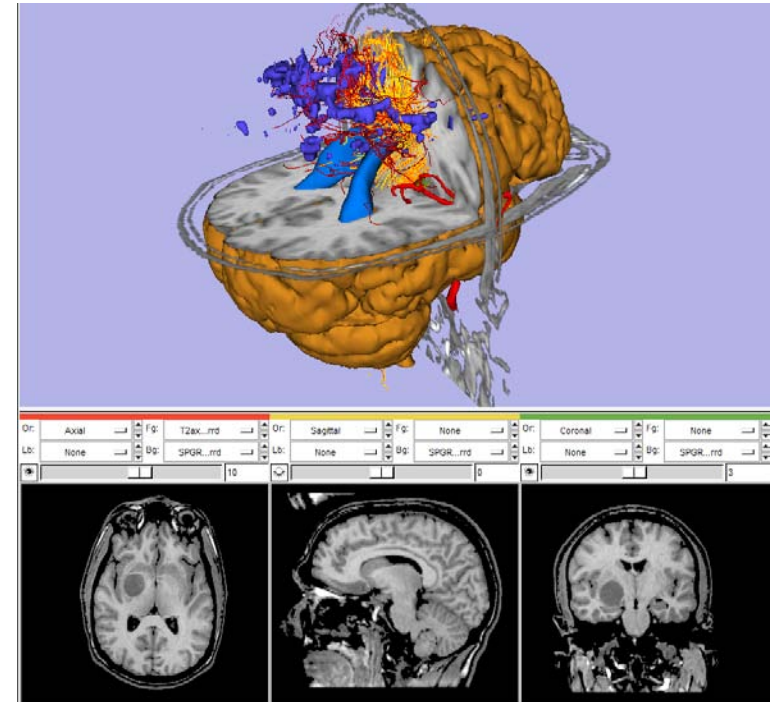
***Three ways to use Slicer and  
the NA-MIC kit***

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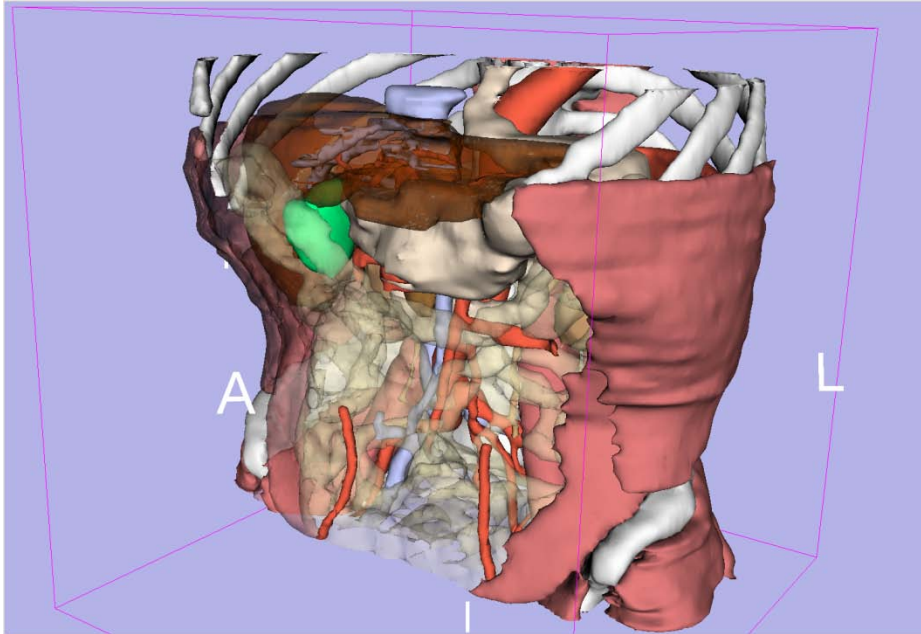
# The NA-MIC kit from three user perspectives

- Clinical researchers
- Biomedical engineers
- Algorithm developers





# *Clinical researchers*

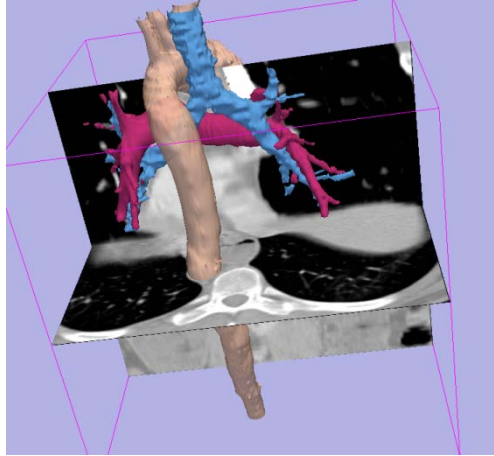
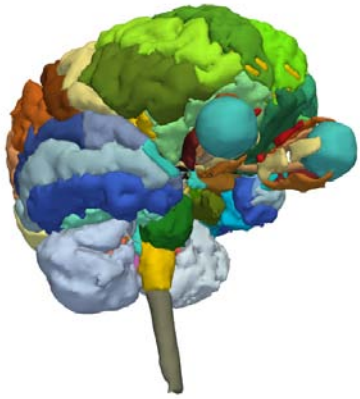


***Interact in 3D to  
enhance data  
interpretation***

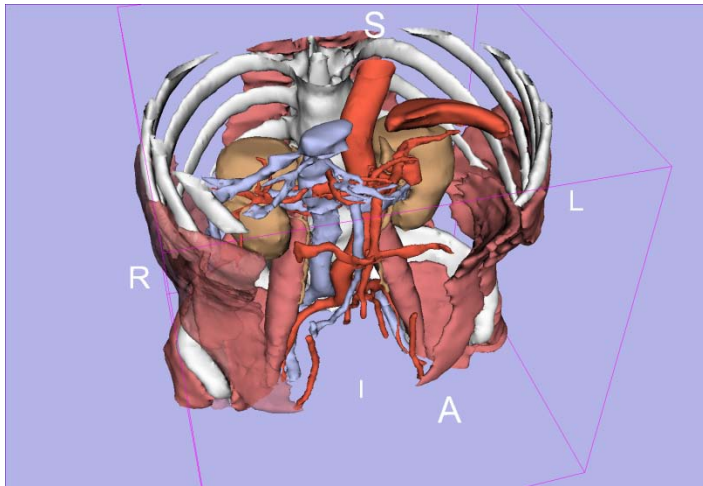




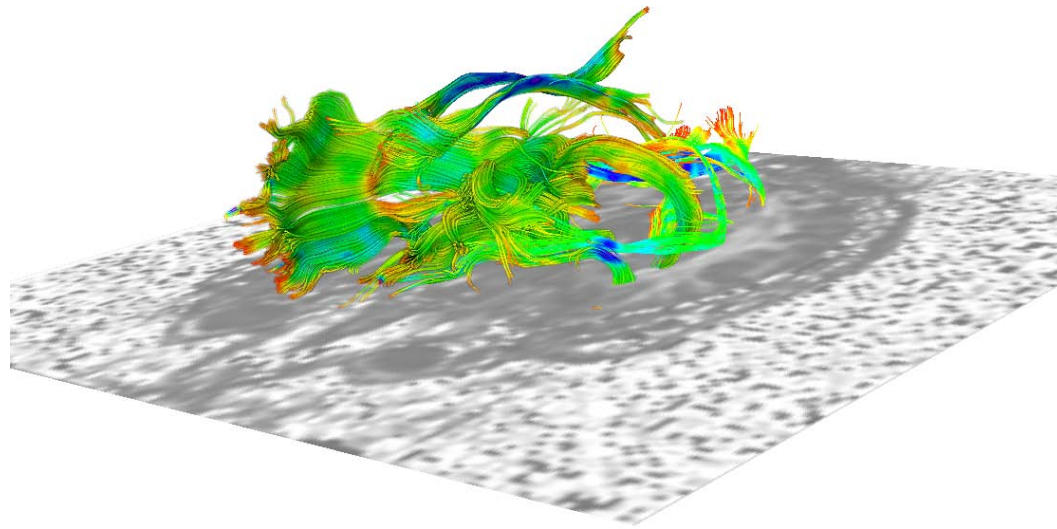
# Visualize



- User-driven views of anatomical structures
- Overlay between 2D grey-levels images and 3D anatomical structures
- Intuitive interaction with the 3D models



# *Biomedical Engineers*

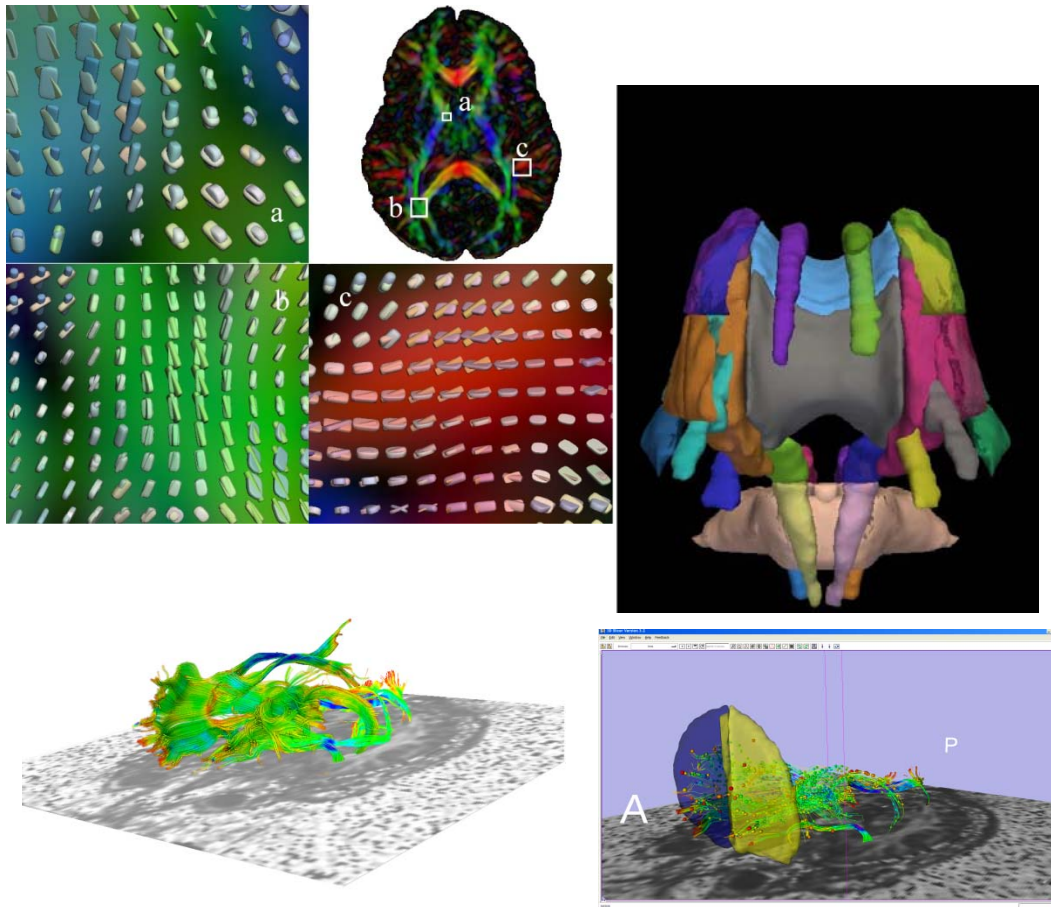


***Extract relevant  
information from  
complex data***





# Analyze

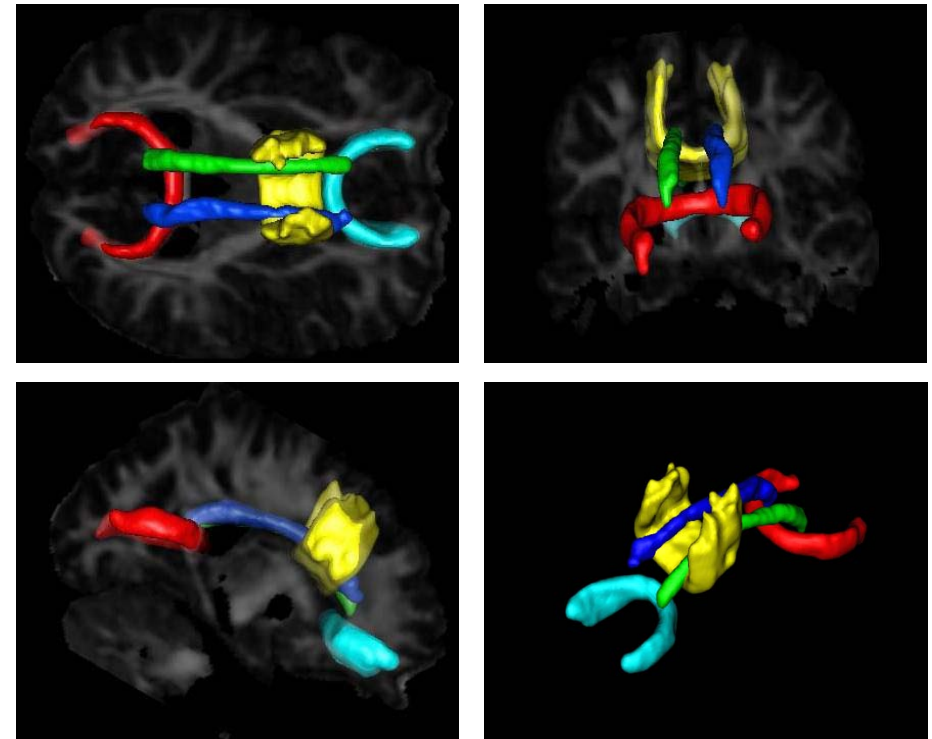
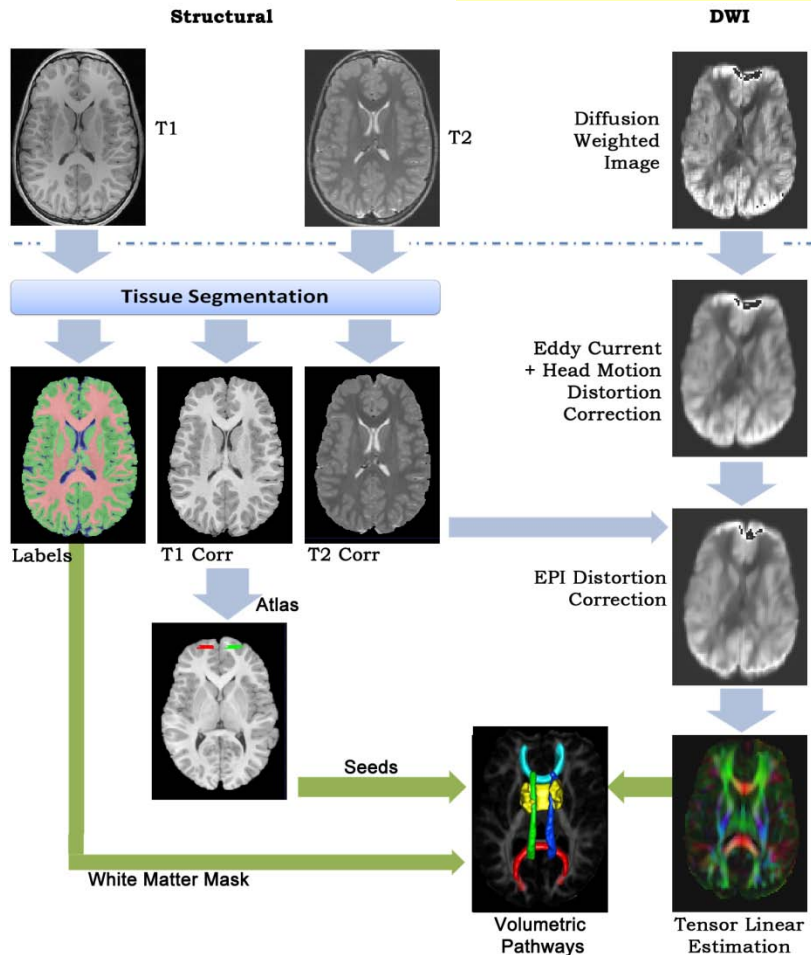


- Advanced analysis of complex data
- Multimodal data fusion
- Clinical parameters extraction



# Analyze

## Statistical Analysis of Anatomy from Medical Images



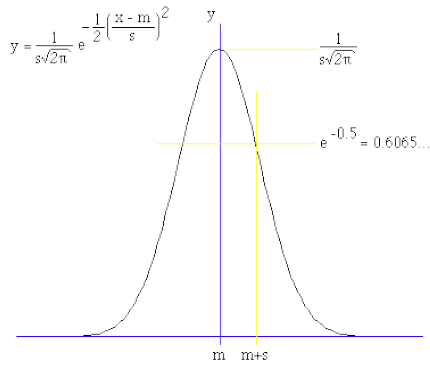
Courtesy of Tom Fletcher, University of Utah.

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National Alliance for Medical Image Computing – Neuroimage Analysis Center

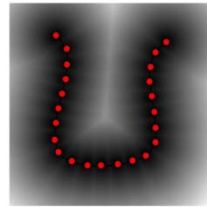
# Algorithm Developers

$$\ln p(X | \pi, \mu, \Sigma) = \sum_{n=1}^N \ln \left\{ \sum_{k=1}^K \pi_k N(x_n | \mu_k, \Sigma_k) \right\}$$

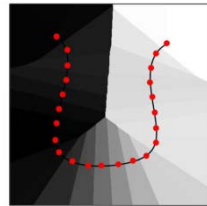


$$p_j^{(k)} = \frac{\sum_{i:D_{ij}=1} W_i^{(k-1)}}{\sum_i W_i^{(k-1)}}$$

$$q_j^{(k)} = \frac{\sum_{i:D_{ij}=0} (1 - W_i^{(k-1)})}{\sum_i (1 - W_i^{(k-1)})}$$



(a)



(b)

**Develop plug-ins to extend image analysis capabilities**

```
#include "itkDiscreteGaussianImageFilter.h"
```

```
int main ( int argc, char * argv[])
```

```
{
    PARSE_ARGS;
    typedef itk::Image< short, 3 > ImageType;
    typedef itk::ImageFileReader< ImageType > ReaderType;
    typedef itk::ImageFileWriter< ImageType > WriterType;
    ReaderType::Pointer reader = ReaderType::New();
    WriterType::Pointer writer = WriterType::New();
    reader->SetFileName(FilterInputVolume.c_str());
    writer->SetFileName(FilterOutputVolume.c_str());
    typedef itk::DiscreteGaussianImageFilter<ImageType, ImageType> FilterType;
    FilterType::Pointer filter = FilterType::New();
```



# Create

The image is a composite of four elements related to medical image computing:

- Top Left:** A screenshot of the CMake 2.6 GUI. It shows the source code path as `C:\SlicerCourses\Programming\HelloWorld` and the build directory as `C:\SlicerCourses\Programming\HelloWorld-build`. The 'Cache Values' section shows `BUILD_TESTING` set to `ON`, `CMAKE_INSTALL_PREFIX` as `C:/Program Files/HelloWorld`, `DART_TESTING_TIMEOUT` as `1500`, and `Slicer3_DIR` as `C:/slicer3dev/Slicer3-build`.
- Top Right:** Three axial brain MRI slices, each highlighted with a yellow border. They show different stages of image processing or registration.
- Middle:** A screenshot of a C++ code editor (Microsoft Visual C++) showing a class view for `EMSegment` and a code editor window. The code editor displays C++ code for an `AlignTargetImagesCallback` function, including logic for setting parent, label, width, and enabling a button.
- Bottom Left:** A 3D visualization of a brain model, showing a mesh structure with a color gradient and a red line indicating a registration or alignment path. A white 'R' is visible in the top left corner of the 3D view.

- Integrate external executables with the Slicer3 platform

- Develop plug-ins in C++, Tcl or Python

- Build upon the NA-MIC kit to meet your scientific goals

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National Alliance for Medical Image Computing – Neuroimage Analysis Center

*Clinical researchers*  
*Biomedical engineers*  
*Algorithm developers*



***Translate  
techniques  
into skills***







# Learn

## Slicer 3.4 Tutorials

The following table contains "How to" tutorials with matched sample data sets. They demonstrate how to use the 3D Slicer

Category	Tutorial	Sample
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## NA-MIC Training Compendium & Workshops

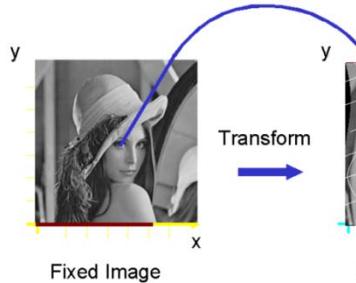


Leonardo da Vinci (1452-1519), *Virgin and Child with St. Anne*, Alte Pinakothek, München

### 3D Visualization



### Deformable transform

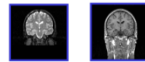


Fixed Image

National Alliance for Medical Image Computing  
<http://na-mic.org>

### EM Pipeline: Patient-Specific Atlas Generation

Registered Normalized Patient data



T(t2n) t1n

Generic atlas



white matter

Atlas to target registration  
 Register the generic atlas to the patient data to create the patient-specific atlas



white matter

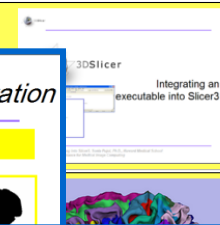
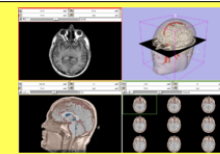
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## Slicer Tutorial Contest

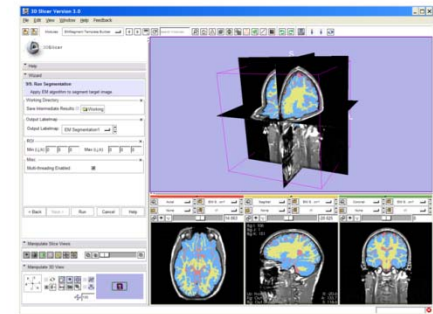
The following tutorials were part of the Summer 2009 Slicer tutorial contest and Winter 2009 Slicer tutorial contest

Contest	Tutorial	Sample
Summer 2009	<a href="#">Confocal Microscopy</a> (First Prize)	
Summer 2009	<a href="#">ARCTIC: Automatic Regional Cortical Thickness V2.1</a>	
Summer 2009	<a href="#">Trans-rectal MR guided prostate biopsy</a>	---
Summer 2009	<a href="#">Python Stochastic Tractography Module</a>	<a href="#">Stochastic Tractography Data</a>
Summer 2009	<a href="#">White Matter Lesions Segmentation V2.2</a>	<a href="#">Lesion Segmentation Tutorial Data</a>

National Alliance for Medical Image Computing – Neuroimage Analysis



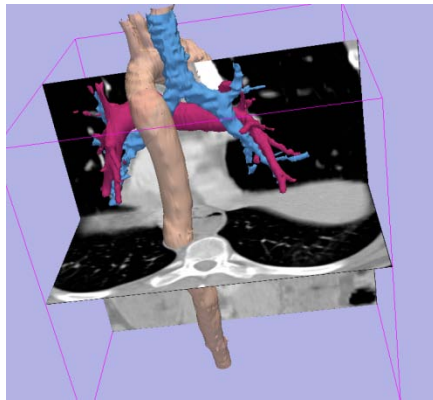
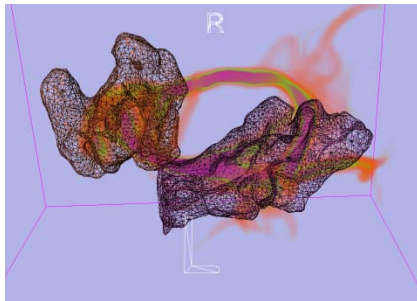
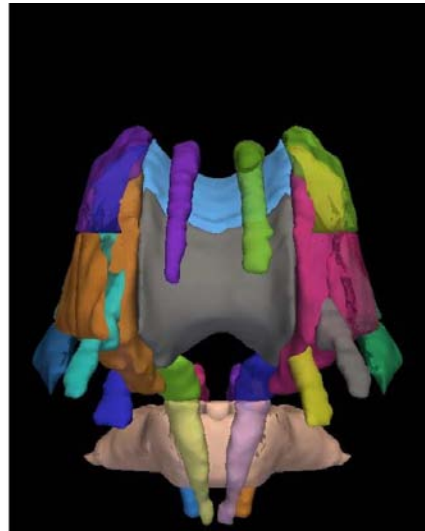
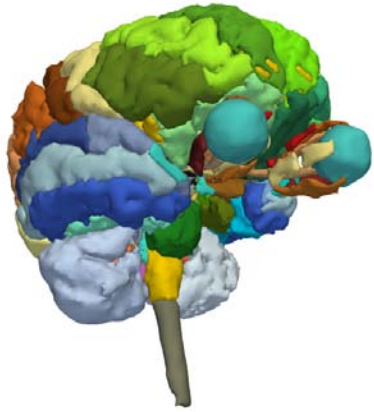
### Segmentation Results



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# Conclusion



- An **end-user application** for image analysis
- An **open-source environment** for software development
- A **technology delivery platform** for community breakthroughs