



NA-MIC

National Alliance for Medical Image Computing

<http://na-mic.org>

Slicer3 and the NA-MIC kit

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Surgical Planning Laboratory

Harvard Medical School

6th Annual World Congress for Brain Mapping and Image Guided Therapy
INTERNATIONAL BRAIN MAPPING AND INTRAOPERATIVE SURGICAL PLANNING SOCIETY - IBMISPS
26-29 August, 2009 • Harvard Medical School, Boston, USA

- Operating room of the future
- Image guided therapy
- Radiosurgical planning
- Multi-modality imaging
- Focused ultrasound

NAC Neuroimage
Analysis
Center



The NA-MIC Kit

3D Slicer



VTK



ITK



Nrrd



KWWidgets



CMake



CTest



Dart



Batch Make XNAT

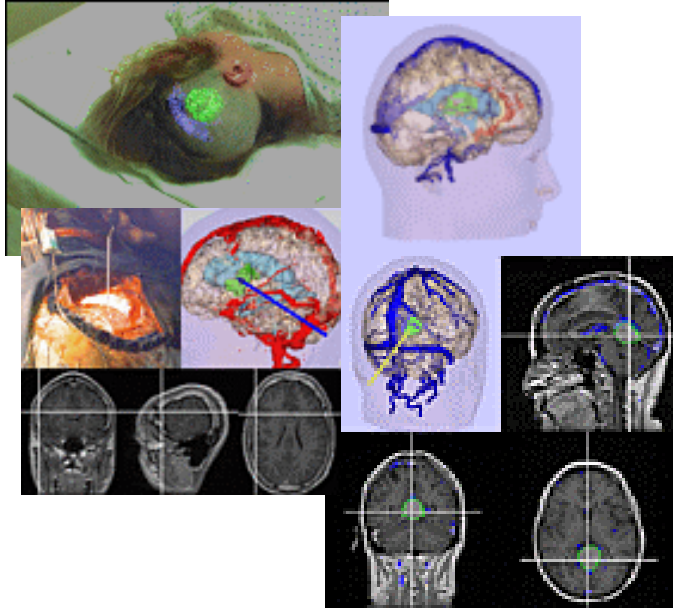


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National Alliance for Medical Image Computing – Neuroimage Analysis Center



3D Slicer History

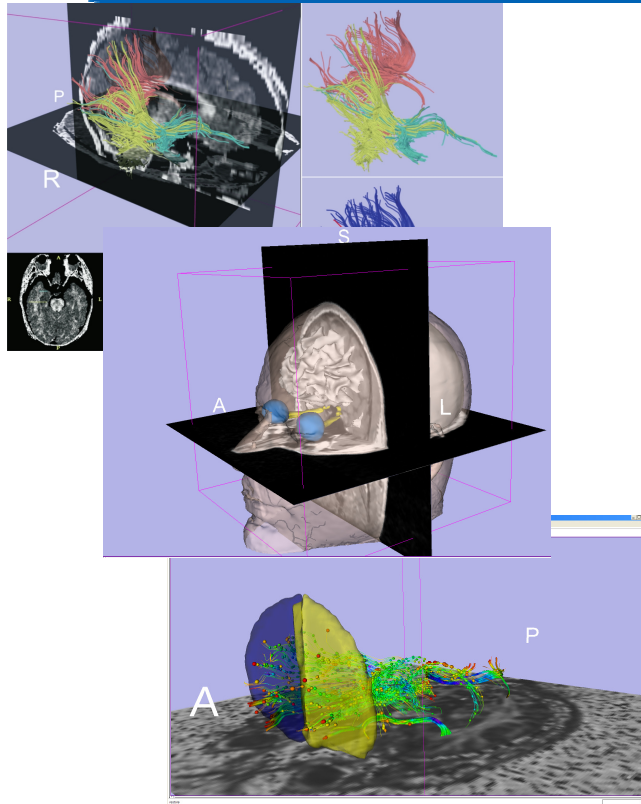


- Started in 1997 between the Surgical Planning Lab (BWH) and the CSAIL (MIT)

Image Courtesy of the CSAIL, MIT



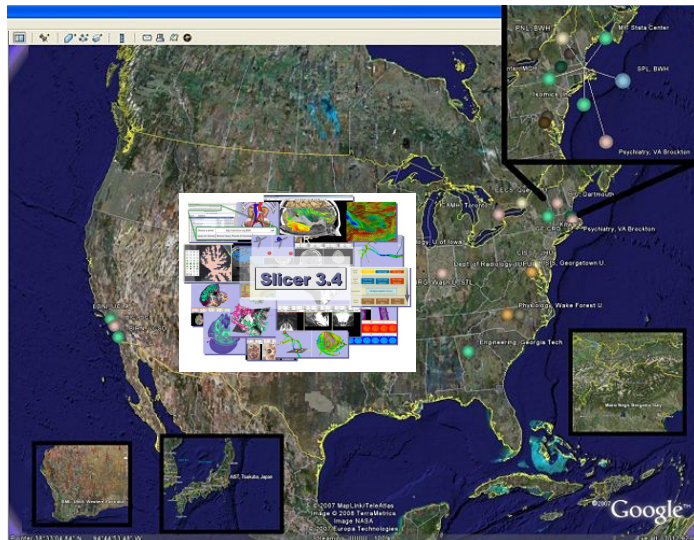
3D Slicer History



- Started in 1997 between the Surgical Planning Lab (BWH) 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

Sonia Pujol, Ph.D.

National Alliance for Medical Image Computing – Neuroimage Analysis Center



NA-MIC

National Alliance for Medical Image Computing

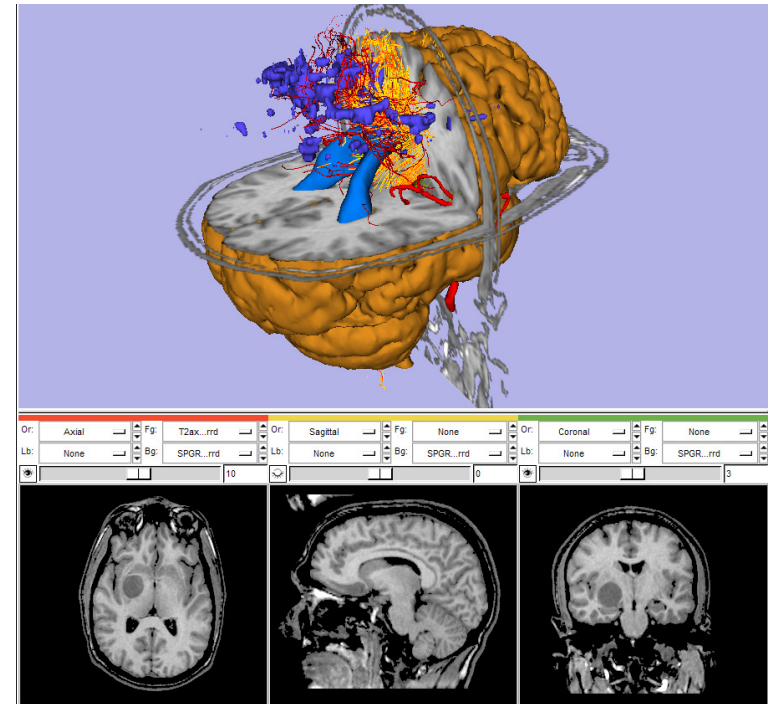
<http://na-mic.org>

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

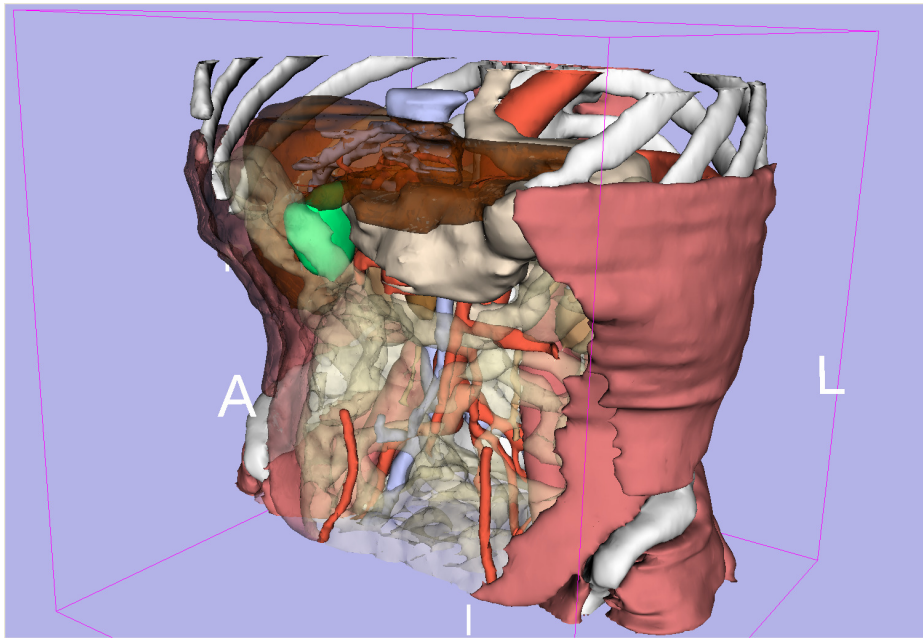


The NA-MIC kit from three user perspectives

- Clinical researchers
- Biomedical engineers
- Algorithm developers



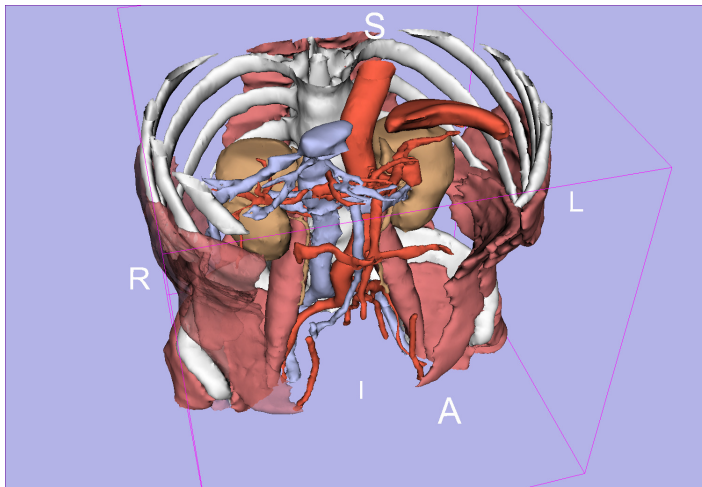
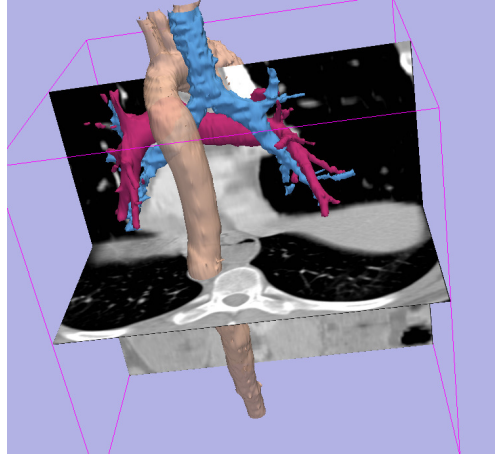
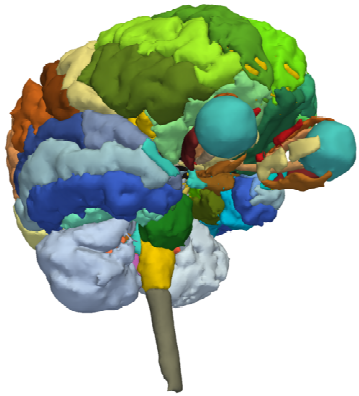
Clinical researchers



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

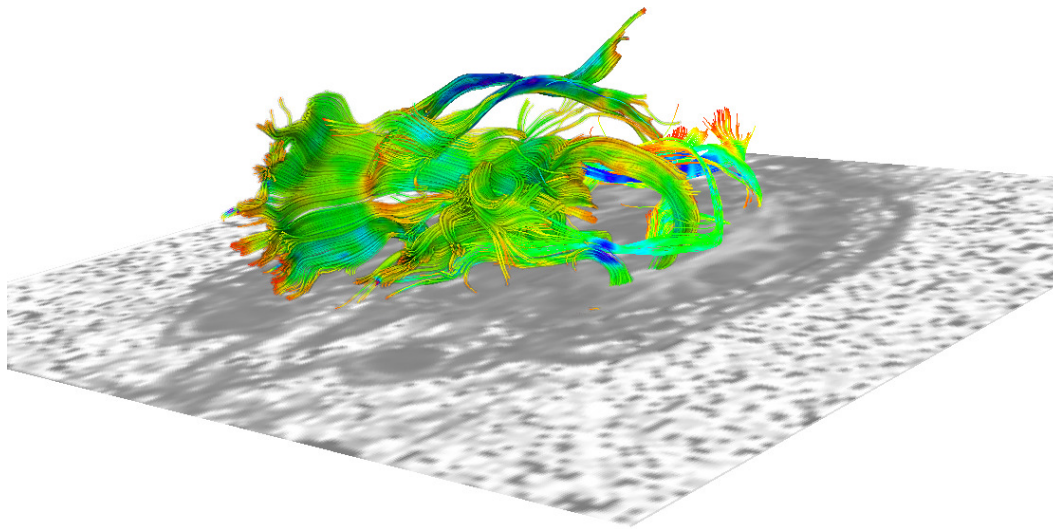


Visualize



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

Biomedical Engineers

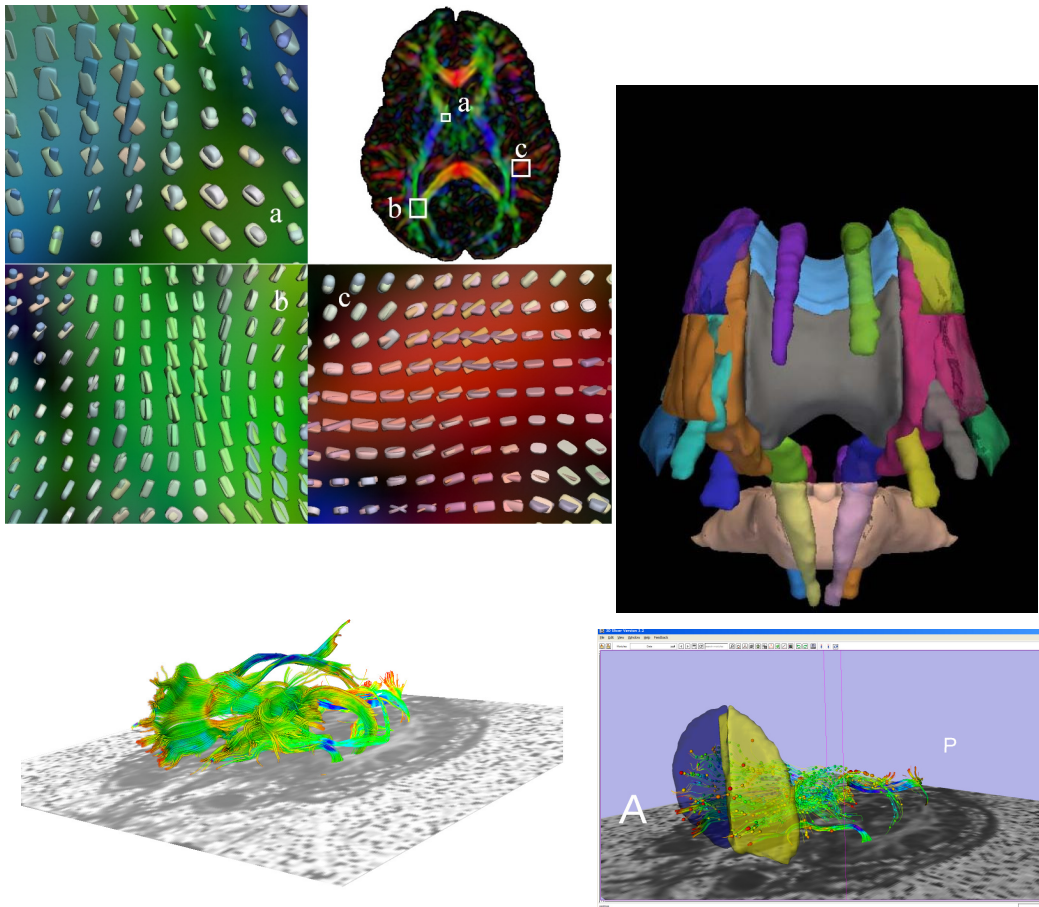


***Extract relevant
information from
complex data***





Analyze

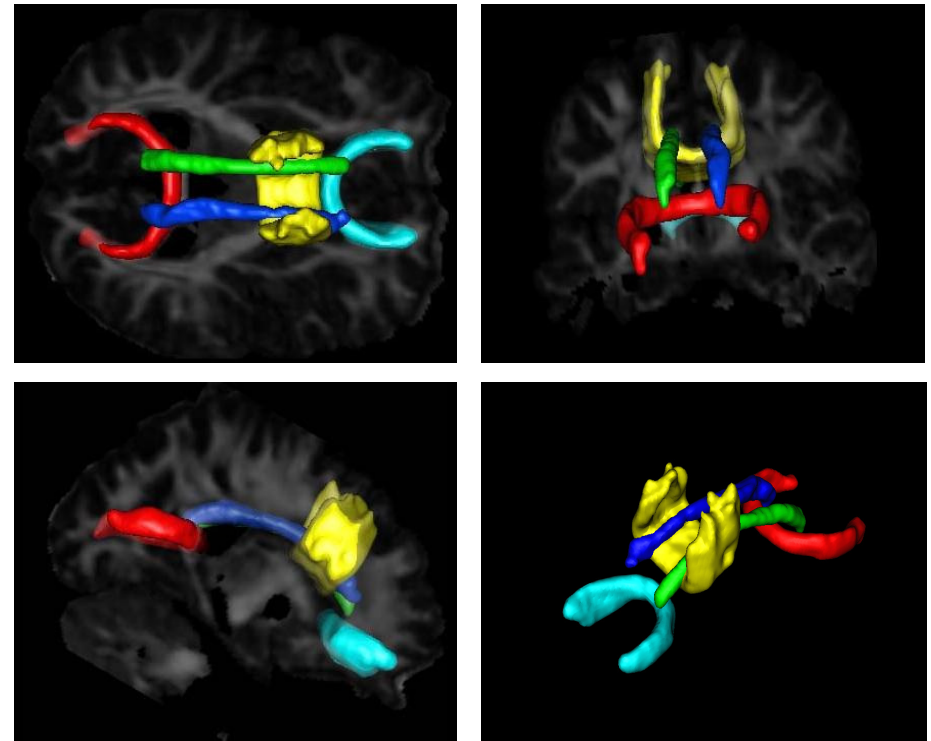
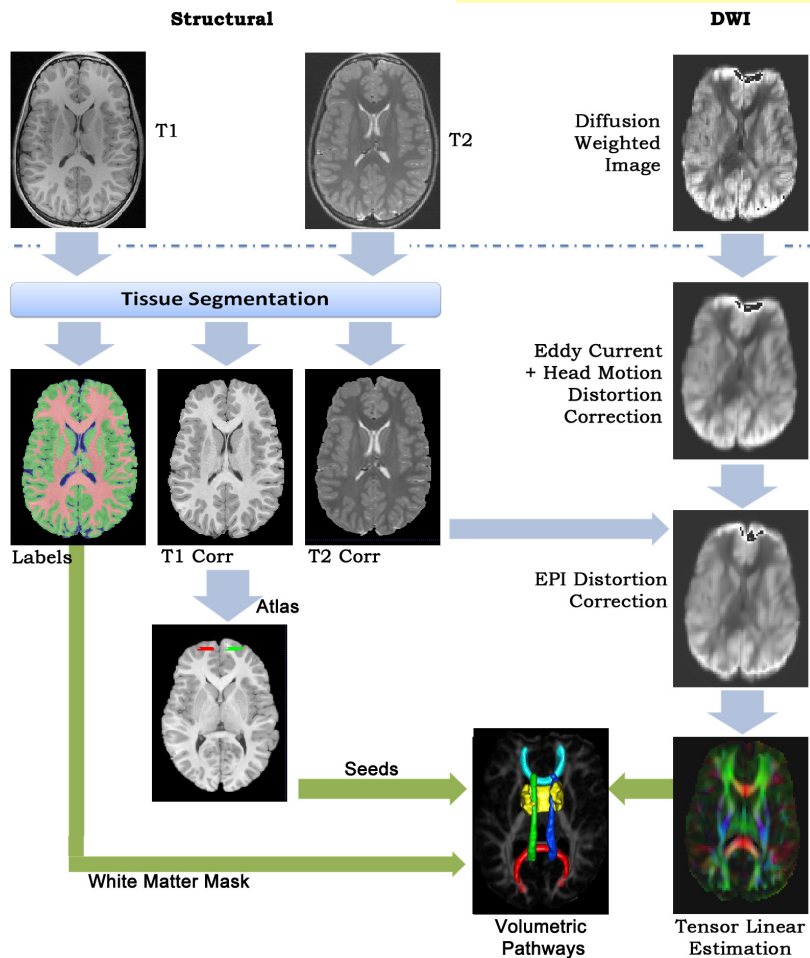


- Advanced analysis of complex data
- Multimodal data fusion
- Clinical parameters extraction



Analyze

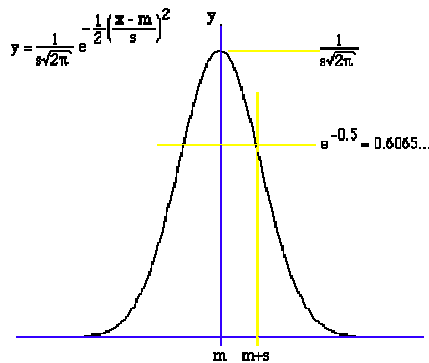
Statistical Analysis of Anatomy from Medical Images



Courtesy of Tom Fletcher, University of Utah.

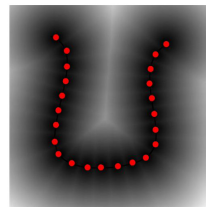
Algorithm Developers

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

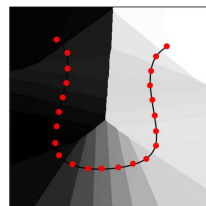


$$p_j^{(k)} = \frac{\sum_{i:D_{ij}=1} W_i^{(k-1)}}{\sum_i W_i^{(k-1)}}$$

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



(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

- 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

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 |
|----------|----------|--------|
|----------|----------|--------|

NA-MIC Training Compendium & Workshops

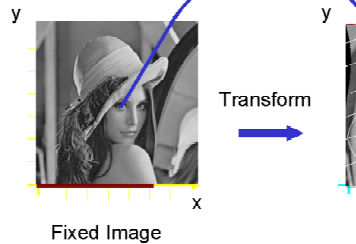


Leonardo da Vinci (1452-1519), *Virgin and Child with St. Anne*, Alte Pinakothek, München

3D Visualization



Deformable transform



NA-MIC Training

Specialized

3D Visualization of F...
The course guides thro...
reconstruction and par...
Audience: All users.

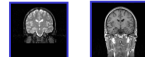
Slicer Tutorial Contest

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

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

EM Pipeline: Patient-Specific Atlas Generation

Registered Normalized Patient data



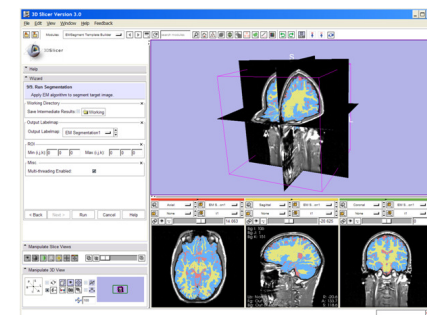
Generic atlas



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

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Segmentation Results



Sonia Pujol, Ph.D., Harvard Medical School
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