3D Interactive Visualization of DICOM images
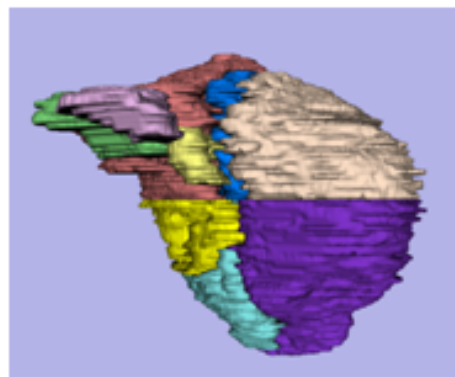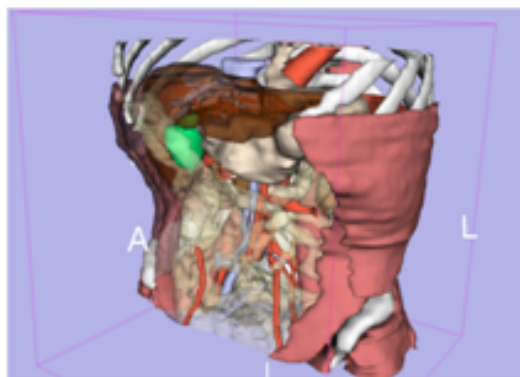
Sonia Pujol, PhD
Brigham and Women's Hospital
Harvard Medical School

Kitt Shaffer, MD, PhD
Boston University Medical Center
Harvard Medical School

Randy Gollub, MD, PhD
Massachusetts General Hospital
Harvard Medical School

Kathryn Hayes, MSE
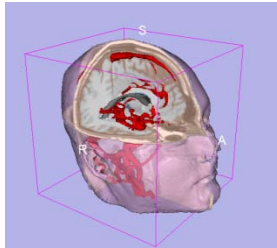**Brigham and Women's Hospital**
Harvard Medical School

Ron Kikinis, MD
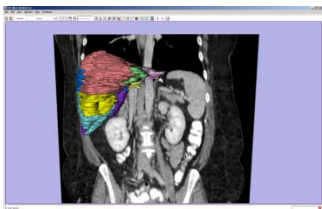**Brigham and Women's Hospital**
Harvard Medical School

Part 1: Introduction to the 3D Slicer platform

Part 2: 3D Visualization of Dicom images and 3D models

Part 3: 3D exploration of liver segments using 3D Slicer

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

- Part 1 -

The 3D Slicer Platform

Sonia Pujol, Ph.D.
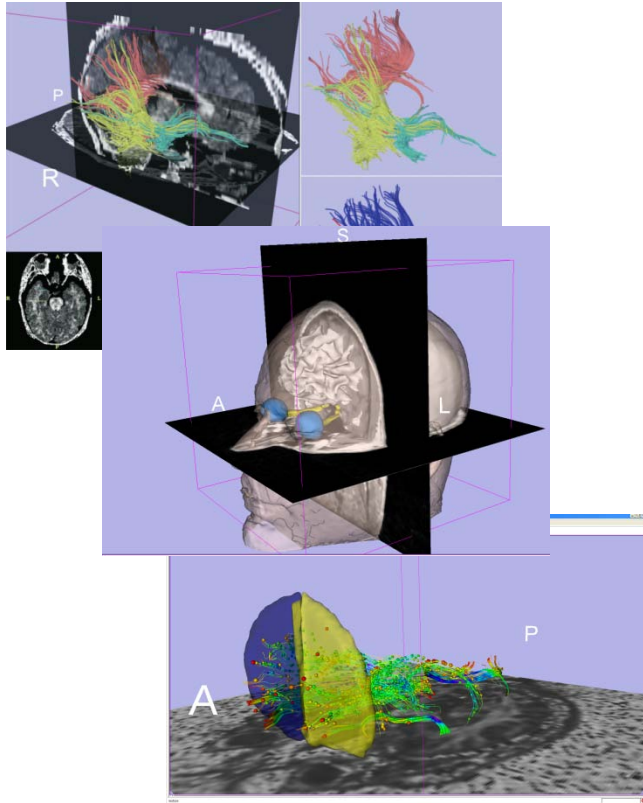
3D Slicer Course for Radiologists, November 30, 2009
RSNA 2009

- Open-source application available for Windows, Linux and Mac

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

3D Slicer

- Open-source application available for Windows, Linux and Mac

- More than 2.8 million lines of code

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

3D Slicer

- Open-source application available for Windows, Linux and Mac

- More than 2.8 million lines of code

- Neuroscience and Image-Guided Therapy

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

3D Slicer History

Image Courtesy of the CSAIL, MIT

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

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

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

*Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.*

National Alliance for Medical Image Computing

3D Slicer
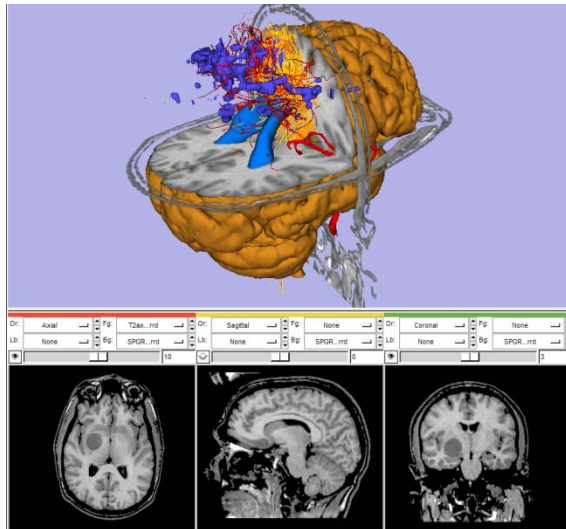
- **Open-source** platform supported by the **National Institutes of Health** consortia which include
  - National Alliance for Medical Image Computing (NA-MIC)
  - Neuroimage Analysis Center (NAC)

  P.I. Prof. Ron Kikinis, MD,

  Director of the Surgical Planning Lab,

  Brigham &Women's Hospital, Boston, MA

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

3DSlicer from three user perspectives

- Clinical researchers

- Biomedical engineers

- Algorithm developers

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.
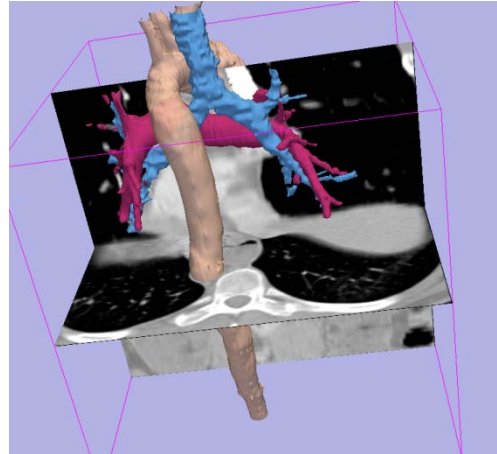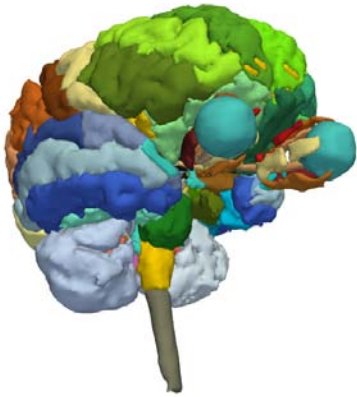
National Alliance for Medical Image Computing
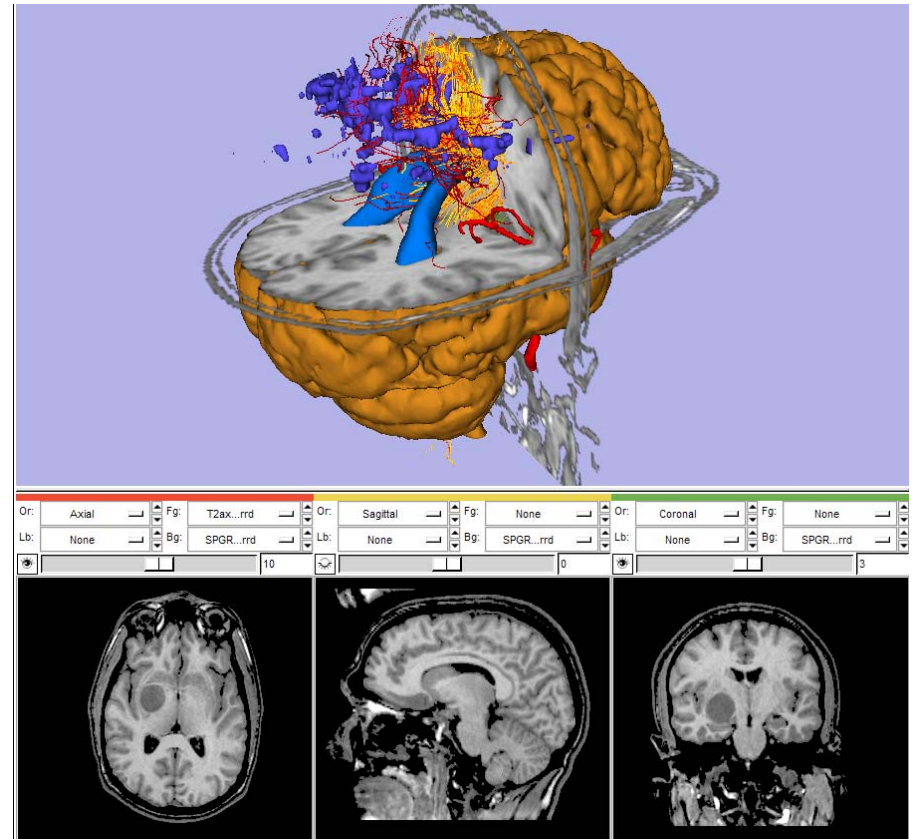
Clinical researchers
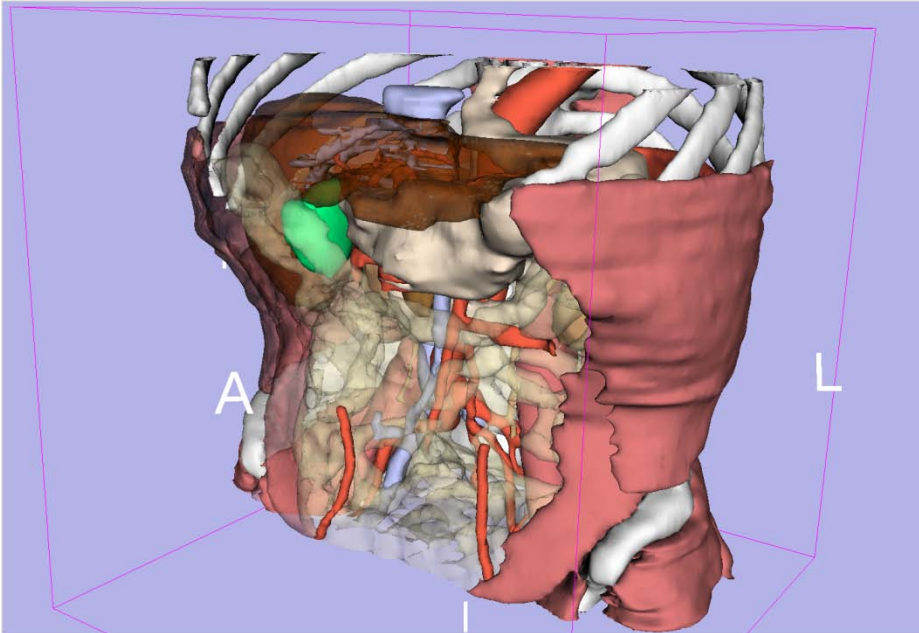
Interact in 3D to
enhance data
interpretation

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

*National Alliance for Medical Image Computing*

Visualize
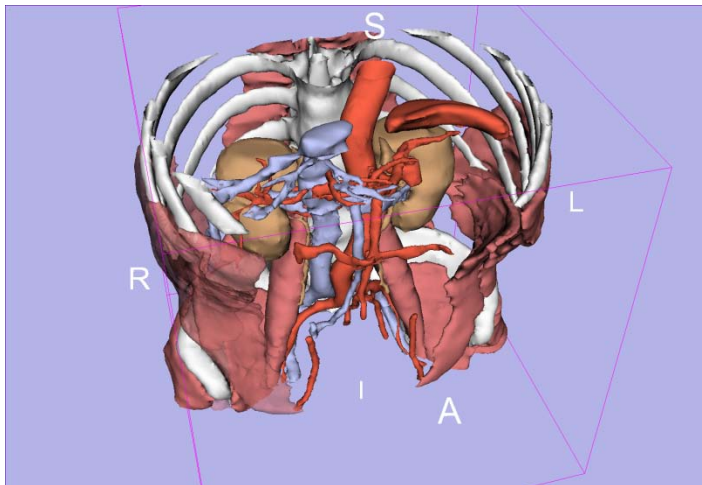
- User-driven views of anatomical structures

- Overlay between 2D grey-levels images and 3D anatomical structures

- Intuitive interaction with the 3D models

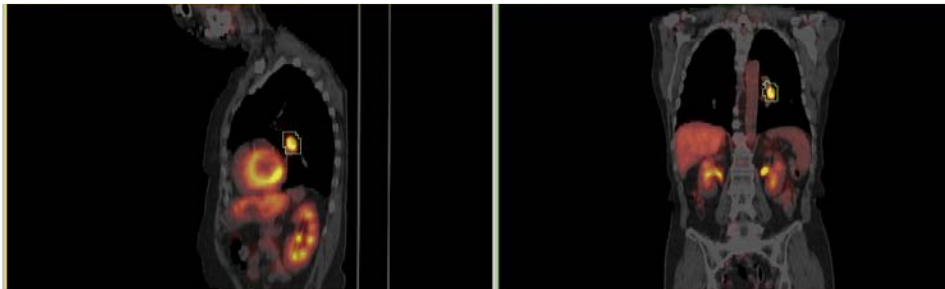*Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.*

National Alliance for Medical Image Computing

Biomedical Engineers
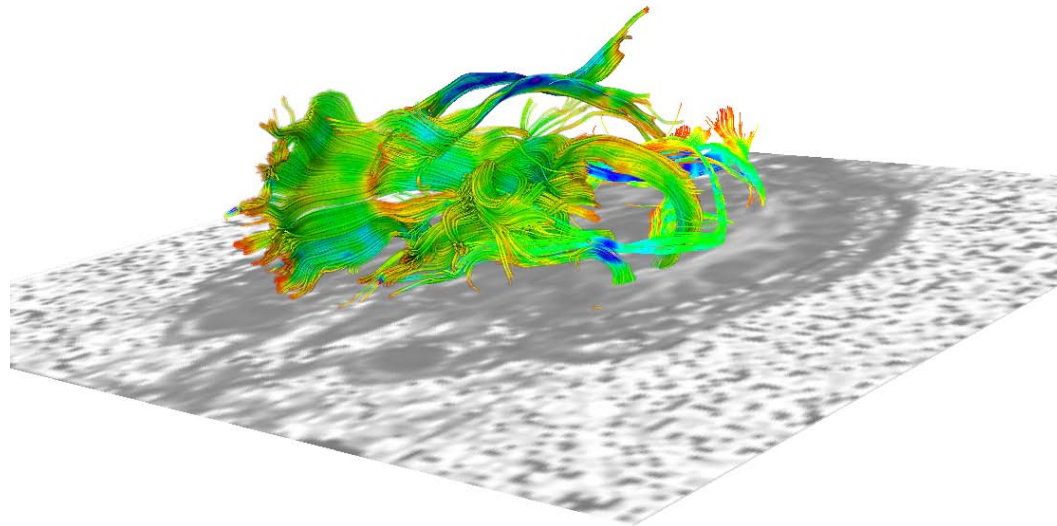
Extract relevant information from complex data
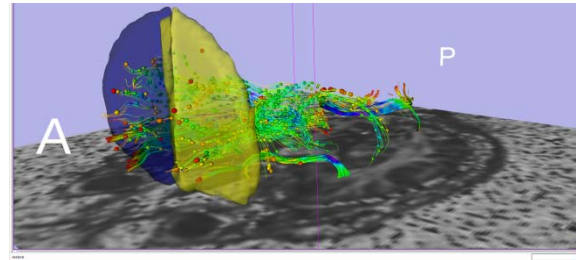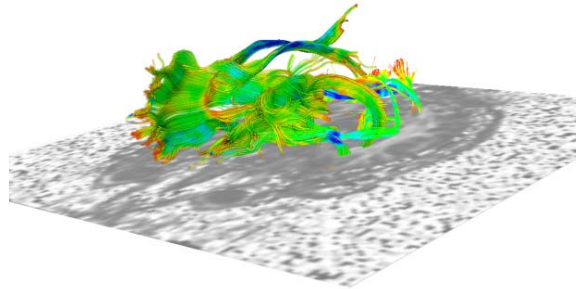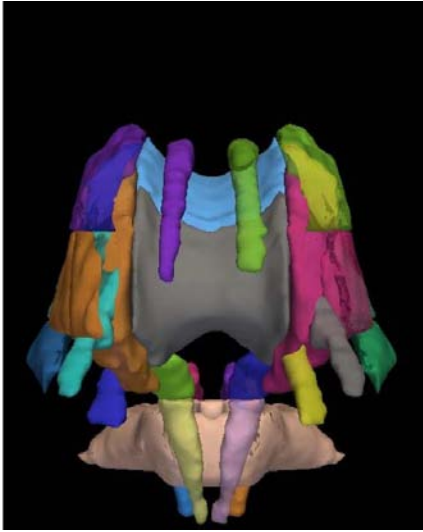
Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

Analyze

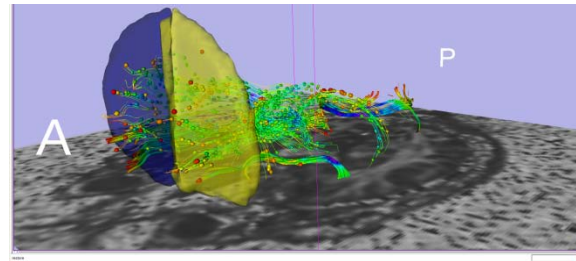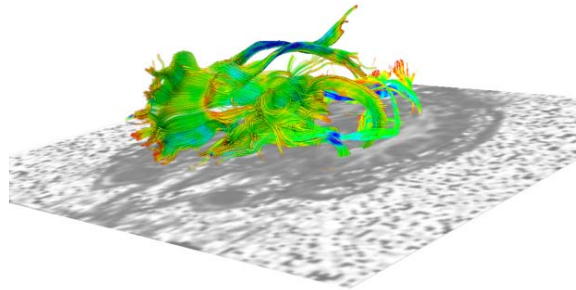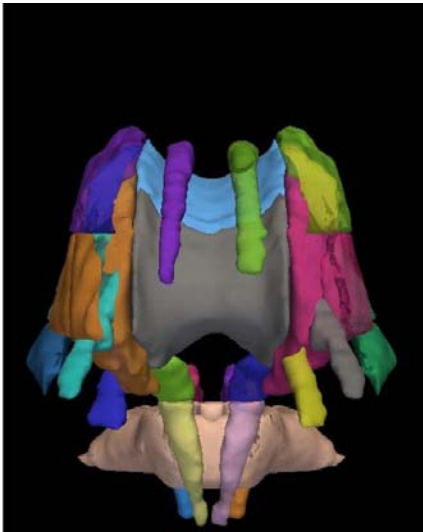- Advanced analysis of complex data

- Multimodal data fusion

- Clinical parameters extraction

Courtesy of W. Plesniak, BWH

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

Analyze

- Advanced analysis of complex data

- Multimodal data fusion

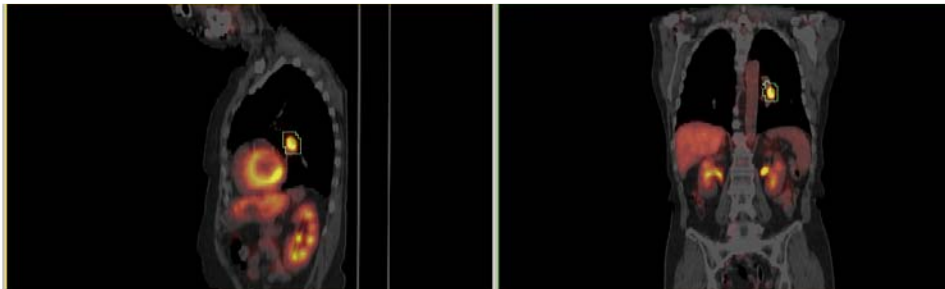- Clinical parameters extraction

Courtesy of W. Plesniak, BWH

RSNA 2009 Course:

'Quantitative Medical Imaging for Clinical Research and Practice'
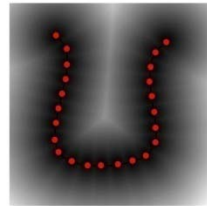
Tuesday, December 01 10:30-12:00 PM S401CD

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

Algorithm Developers

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

$$y = \frac{1}{s\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-m}{s}\right)^2}$$

$$\frac{1}{s\sqrt{2\pi}}$$

$$e^{-0.5} = 0.6065...$$
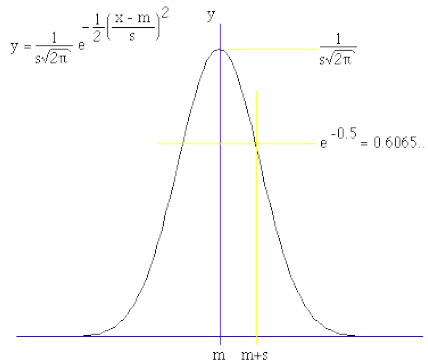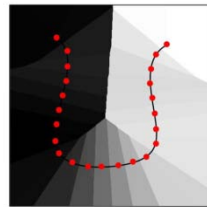
$$p_j^{(k)} = \frac{\sum_{i:D_{ij}=1} W_i^{(k-1)}}{\sum_i W_i^{(k-1)}}$$

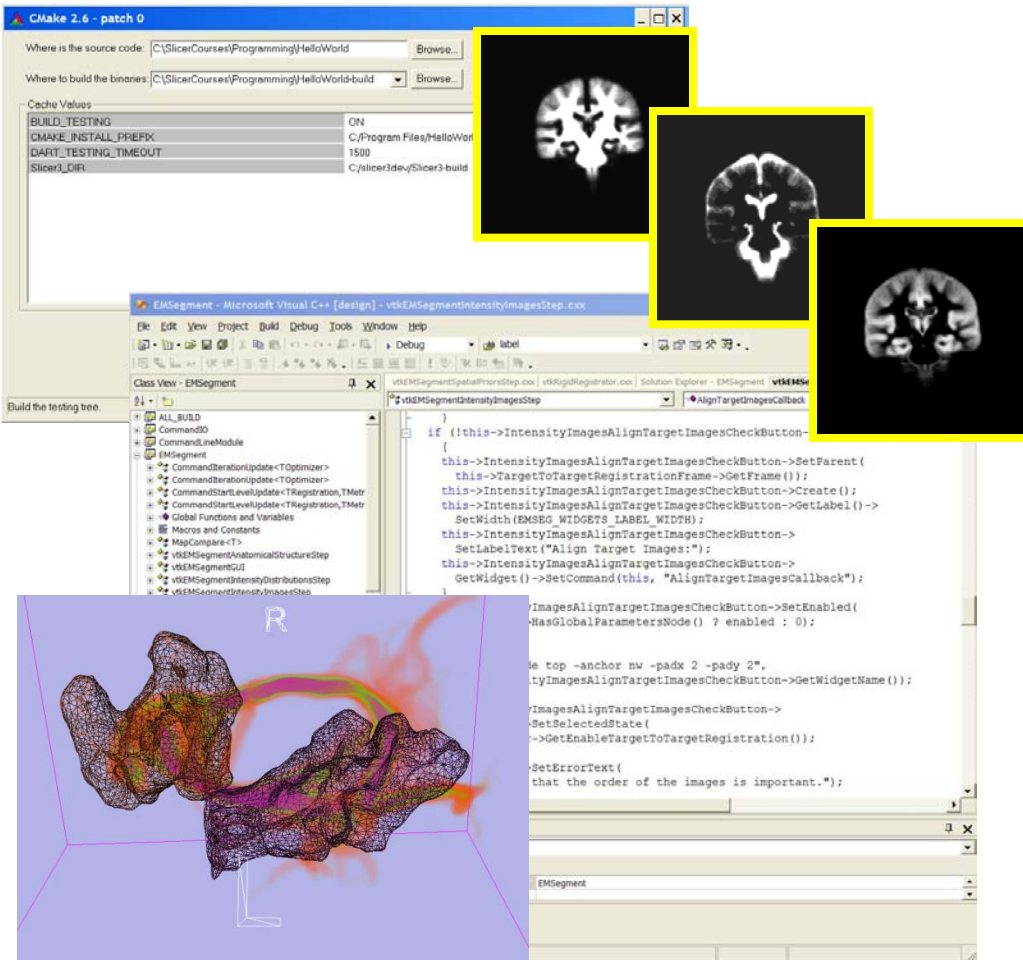$$q_j^{(k)} = \frac{\sum_{i:D_{ij}=0} \left(1 - W_i^{(k-1)}\right)}{\sum_i \left(1 - W_i^{(k-1)}\right)}.$$

(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();
```

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

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

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

Clinical researchers
Biomedical engineers
Algorithm developers

Translate techniques into skills

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing

Translate Techniques into Skills

3DSlicer hands-on workshops

•Clinical researchers

•Biomedical engineers

•Algorithm developers

Sonia Pujol, Ph.D. – Kitt Shaffer, M.D., Ph.D.

National Alliance for Medical Image Computing