



# Visualization and analysis of medical data through the Internet

MIDAS - The Digital Archiving System

Charles Marion – CrEDIBLE 2013

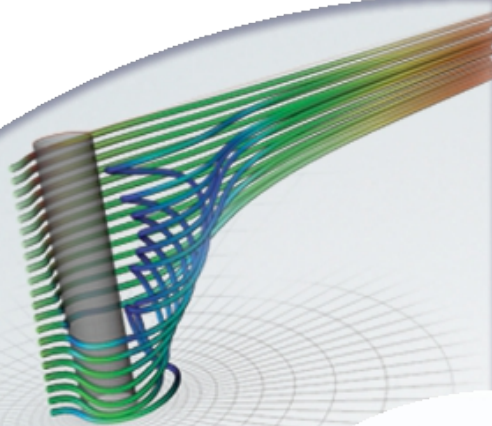
# Kitware

- Founded in 1998
  - Support VTK (Visualization Toolkit) software
  - Five founders from GE Research
- Now ~120 employees
  - 75+ PhD and Masters
  - Research-quality staff
- \$20 million revenue
  - Privately owned
  - No debt
- Offices
  - Clifton Park, NY (USA)
  - Chapel Hill, NC (USA)
  - Santa Fe, NM (USA)
  - Lyon (France)



# SOFTWARE PROCESS

**SUPERCOMPUTING  
VISUALIZATION**



**MEDICAL  
IMAGING**



**COMPUTER  
VISION**

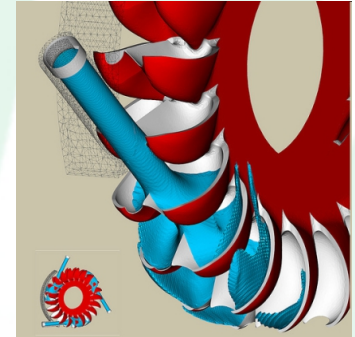


**DATA  
MANAGEMENT**



# Open Source Systems

- **VTK** – Visualization Toolkit
- **ParaView** – Large data visualization
- **Titan** – Informatics Toolkit
- **ITK** – Insight image analysis toolkit
- **3D Slicer** – Medical research platform
- **CMake** – Cross-Platform Build
- **IGSTK, CTK, VXL, Avogadro**, more....



# Motivation

- Scientific datasets are becoming larger and larger (increasing resolution, new modalities, ...)
- **Storing** datasets is the first step but **querying** and **retrieving** them is even more important
- Related documents should be stored along with the corresponding datasets
- Data without **metadata** information are useless
- Distributed and remote computing is becoming a necessity
- Distributed visualization is an emerging technology
- Goal is to increase **collaboration** between research teams

# What is Midas?

- An **open source** platform for building **data management systems**
- Built on:
  - Apache2
  - MySQL (or PostgreSQL)
  - PHP 5.3+
- Easy to Install
- Easy to Use



# History

- Midas 1.0 **started in 2005**
- Initially based on DSpace
- Designed to host publications and companion data
- Up until 2.8 Midas used CakePHP as its MVC Framework
- Midas 2.X powers:
  - Give A Scan
  - The Insight Journal
  - The Retrospective Image Registration Evaluation (RIRE)
  - Many others...

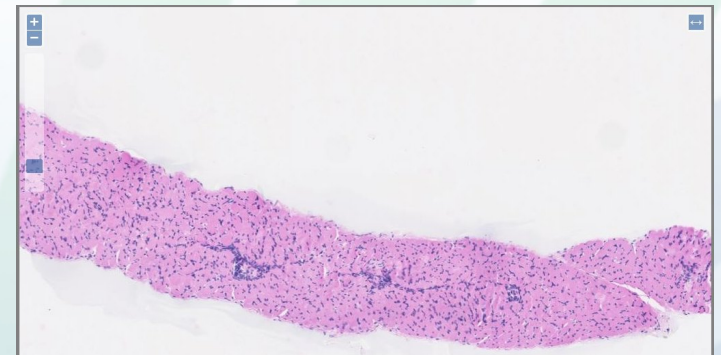
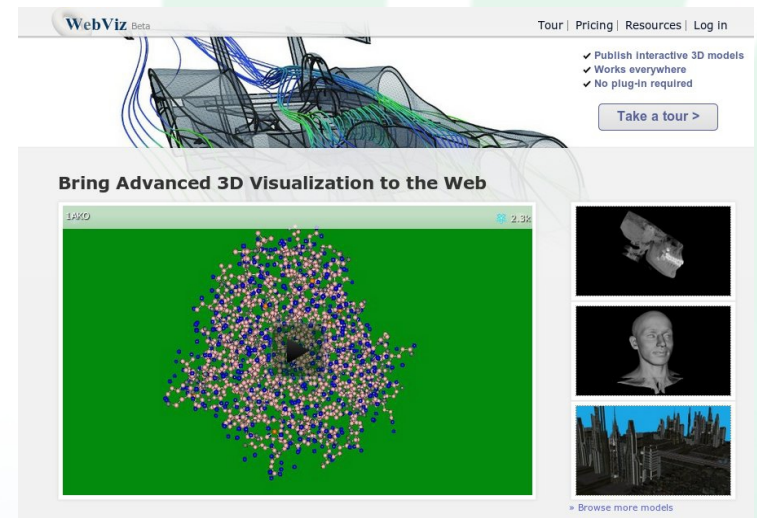
# Funding and Support

- Public Sector Support
  - NCI
  - NLM
  - NIBIB
  - NIST
  - DARPA
  - IARPA
  - TSA
  - VA
- Private Sector Support
  - Medical Device Manufacturing
  - Industrial Quality Assurance
  - Industrial Research and Development
  - Scientific Publishing
- Current Midas-Supporting Projects
  - iDASH
  - NA-MIC
  - COVALIC (Phase I SBIR)
  - Phase II Rodent Imaging STTR with UNC
  - OSEHRA
  - QIBA (Committee for Open Image Archives)
  - NIST (QI-Bench)
  - Kitware Internal Projects



# Midas' main features

- Upload/Download
- Sharing
- Search
- **Extensibility**



# Alternative open source solutions




- Supports all common imaging methods (e.g. MRI, CT, PET)
- Organize and Share Data
- Search and Explore Large Data Sets
- Demo: <https://central.xnat.org/>



- Support multi-centric research studies
- Organize and Share Data
- Search and Explore Large Data Sets
- Demo: <https://shanoir-demo.irisa.fr:8643/Shanoir>

# XNAT

Logged in as: [Guest](#) | [Login](#) | [Register](#)



[Home](#) [Tools](#) [Search](#) [Advanced](#)

Projects

Recent

[ADHD200](#)  
[Aging\\_TAU](#)  
[BWH MRI Prostate](#)  
[Decoding true answers](#)  
[Dicomphantoms](#)  
[DRC\\_test1](#)  
[GWE Test Data](#)  
[JRH Functional Test Pro](#)  
[LONI Pipeline ICBM Data](#)  
[mBIRN Calibration](#)  
[NAMIC High Res DTI](#)  
[NCIGT Functional Neuro](#)  
[NCIGT Intraop Glioma](#)  
[Neuro-MRT genesis data](#)  
[Neuro-MRT Image Database](#)  
[NipypeTest](#)  
[OASIS\\_CS](#)  
[OASIS\\_LONG](#)  
[PALS](#)  
[project](#)  
[Sample\\_DICOM](#)  
[surfmask\\_smp1](#)  
[XNATSlicerTest](#)

Favorite

My projects

Other projects

Stored Searches

Data

Prostate MRI Database

Details

**ID:** NCIGT\_PROSTATE

**Description:** BWH MRI Prostate data. 10 datasets, including a derived segmentation series with labelmaps.

**PI:** Jolesz, Ferenc

Subjects

SELECT

<< first < prev 1 next > last >> 20 1 of 1 Pgs (10 Rows) Reload Options

| Subject | M/F | Hand | YOB | MR Sessions |
|---------|-----|------|-----|-------------|
| case057 | M   | U    |     | 1           |
| case124 | M   | U    |     | 1           |
| case142 | M   | U    |     | 1           |
| case190 | M   | U    |     | 1           |
| case207 | M   | U    |     | 1           |
| case221 | M   | U    |     | 1           |
| case222 | M   | U    |     | 1           |
| case223 | M   | U    |     | 1           |
| case224 | M   | U    |     | 1           |
| case227 | M   | U    |     | 1           |

# Shanoir



User: user

Online users: [ user ]

[Help](#) [Contact](#) [About](#) [Logout](#)



Manage Data



Import Data



My Shanoir



Preferences



Actions

[Home](#)

## Welcome to Shanoir



Shanoir is a new software that will allow you to share, upload, manage and download clinical and medical metadata and data.

With Shanoir, it's now easy to share data between medical doctors, researchers and PhD students!



[Explore the Research Studies](#)



[Find and Download Datasets](#)

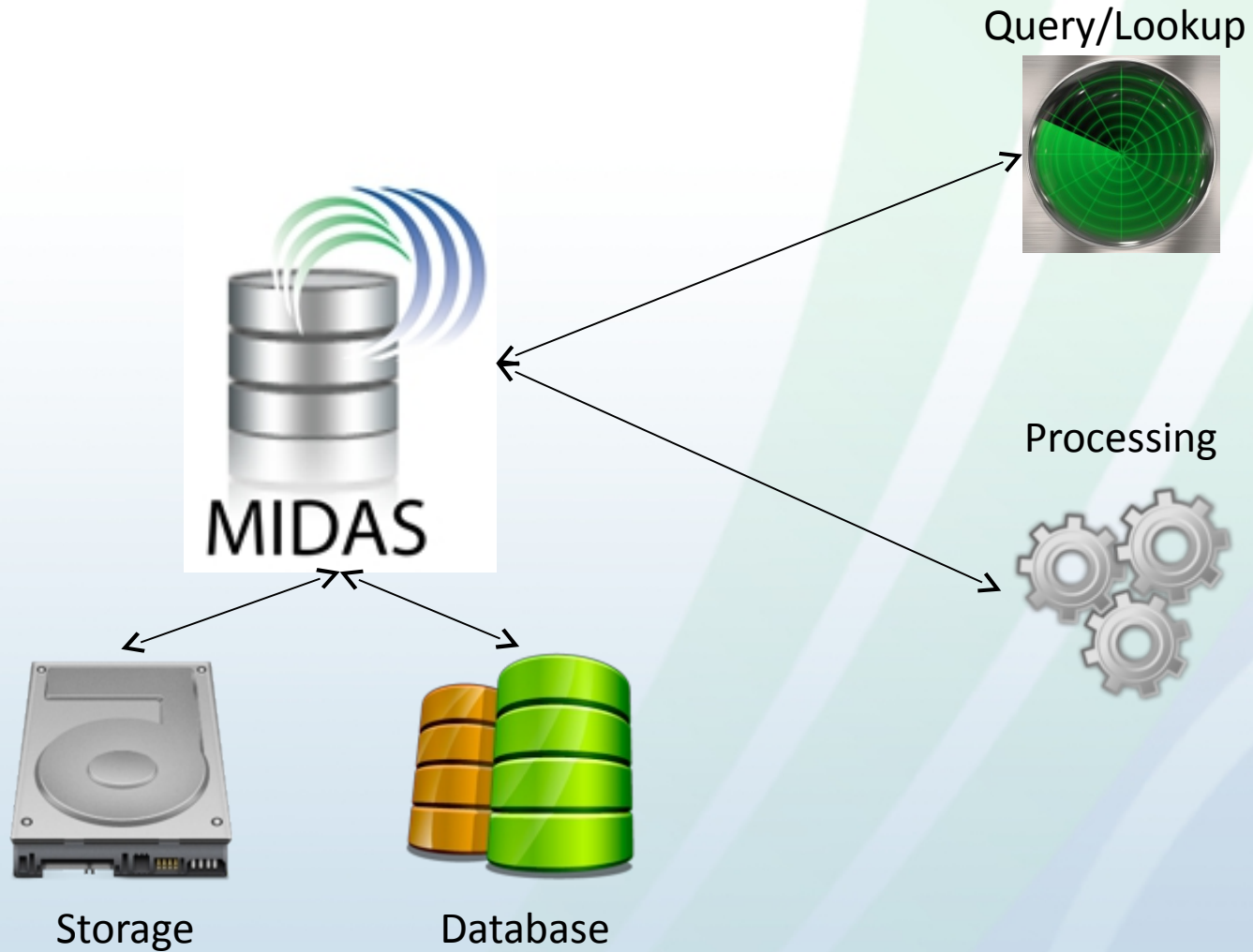


[Find Clinical Scores](#)

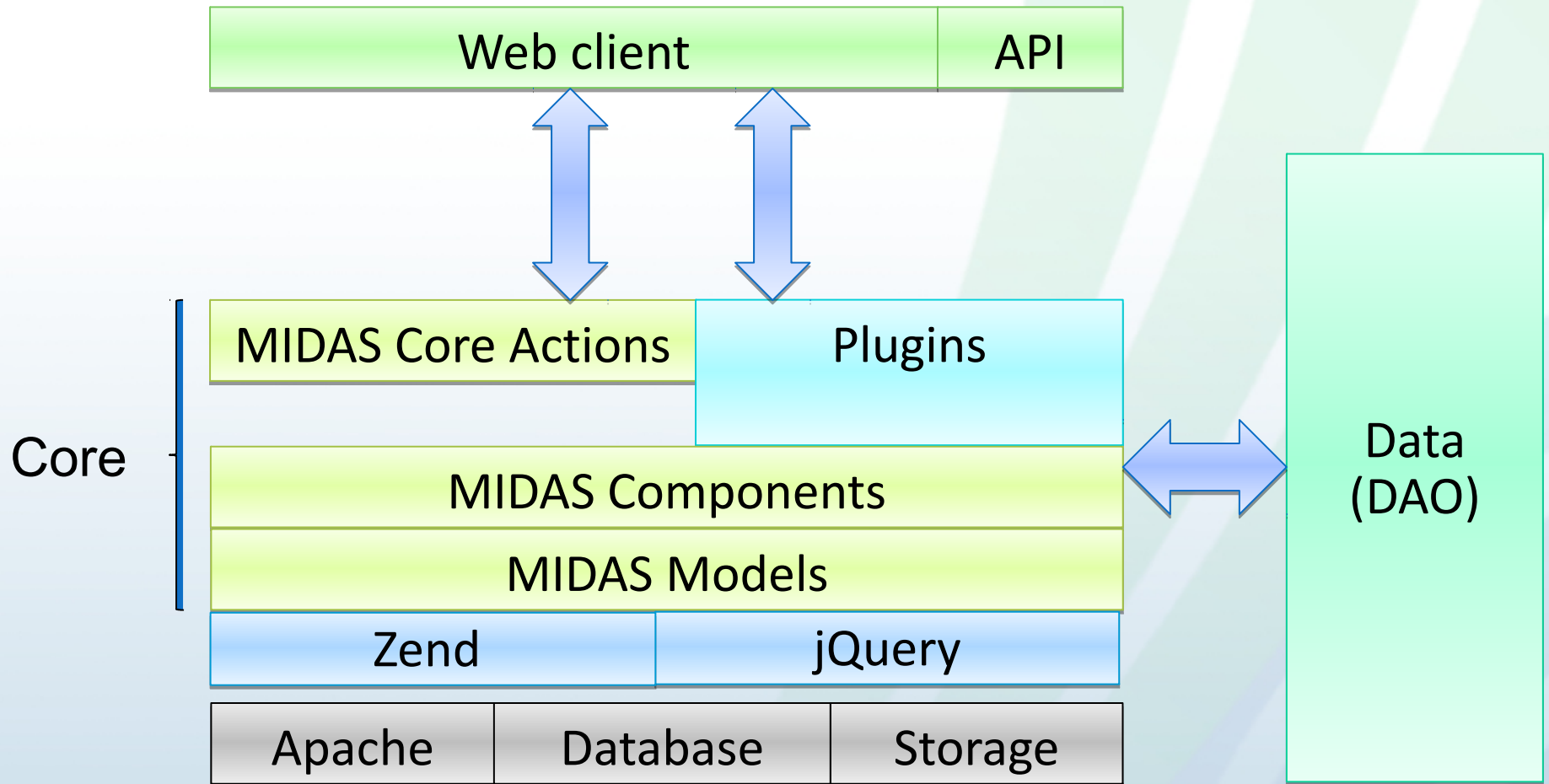


[Import Data](#)

# MIDAS Architecture

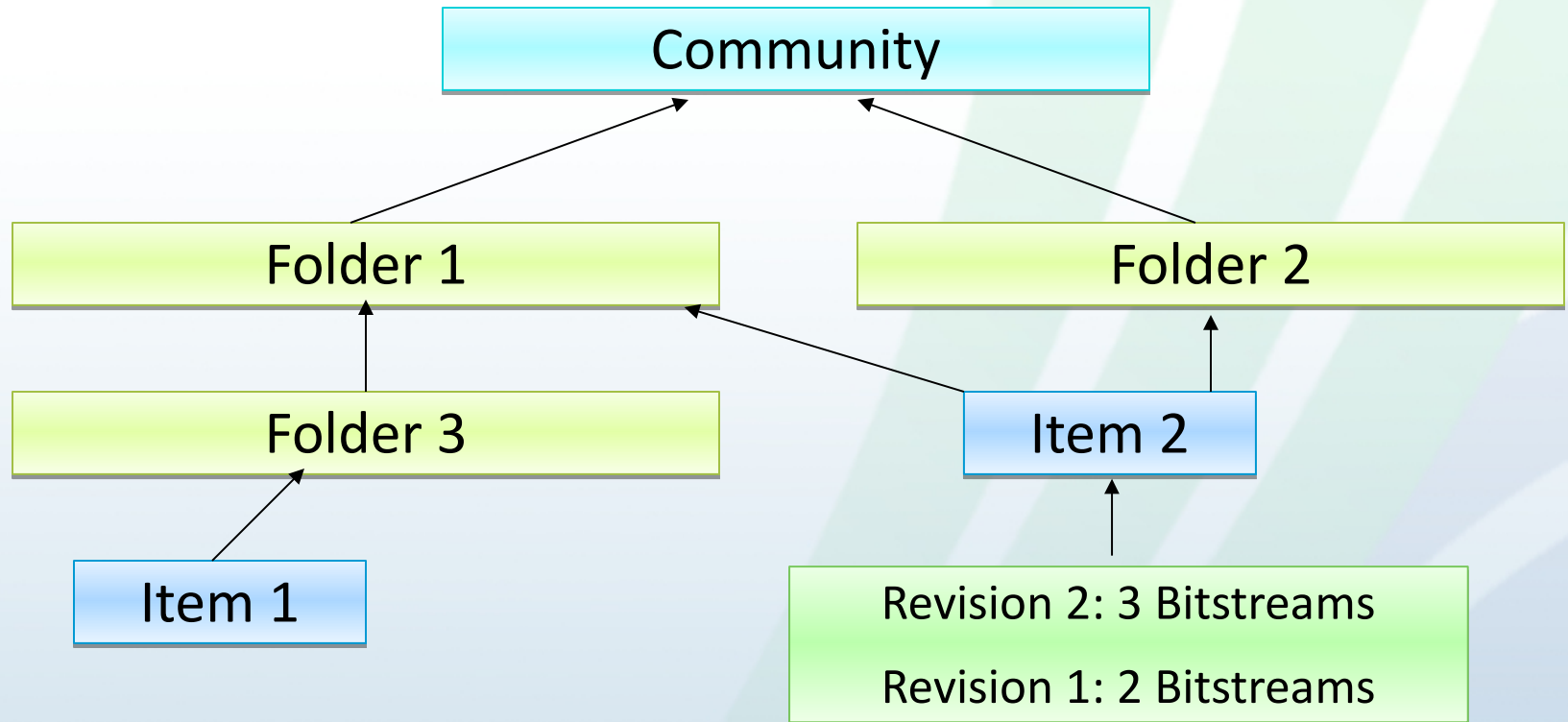


# MIDAS Architecture





# Data Hierarchy



# Item View

**iDASH**[Upload](#)

Feed

Explore

Communities

Users

My space

RECENTLY VIEWED

rdk2\_...e001\_x41.png

Kawasaki Disease

Private

Pediatric

rkd2

**rdk2\_merged\_phase001\_y259.png**  
69.2 KB

[Download](#)

**ACTIONS**

Share

Duplicate

Edit

Add Metadata

Upload new revision

Annotate image

**INFO**

Created 07/16/2012

Uploaded by [Brian Chapman](#)

Views 1

Downloads 0

Revisions 1

Files 1

vare

# Metadata and Search in Midas

- Midas has support for arbitrary **key-value metadata**
- There are several modules for **automatic extraction of metadata** for known data types:
  - PDF
  - DICOM
  - JPEG
  - Many more...
- Search can use either native SQL or **Apache Solr** for indexing and search of data
- Solr allows users to query massive sets of data with a convenient syntax

# Built-in meta data & version control

The screenshot displays the iDASH web interface. The top navigation bar includes the iDASH logo, a search bar, and an 'Upload' button. The left sidebar contains navigation links: Feed, Explore, Communities, Users, My space, and a 'RECENTLY VIEWED' section listing 'rkd2\_merged\_phase...' and 'rkd2\_...001.nii.xml'.

The main content area shows the file 'rkd2\_merged\_phase001.nii.xml' (15.9 KB) under the path 'Kawasaki Disease > Private > Pediatric > rkd2'. A 'Download' button is present. Below the file name, the 'LICENSE' section states 'No license set on the current revision.'

The 'HISTORY' section is highlighted with a red box and shows 'Revision 3'. Below this, the upload date and time are listed: 'Uploaded 2012-07-13 19:23:05 by Mona Wong'. A 'Download' button with a red 'X' icon is also visible.

A table, also highlighted with a red box, displays the metadata for the current revision:

| Element | Qualifier | Value                          |
|---------|-----------|--------------------------------|
| 1       |           | proximal right coronary artery |
| 3       |           | aneurysm                       |
| 2       |           | left coronary artery           |

Below the table, the 'CONTENT' section shows a table with the file name and size:

| Name                         | Size    |
|------------------------------|---------|
| rkd2_merged_phase001.nii.xml | 15.9 KB |

At the bottom of the main content area, there are links for 'Revision 2' and 'Revision 1'.

The right sidebar contains an 'ACTIONS' menu with options: Share, Duplicate, Edit, Add Metadata, Upload new revision, Permissions, and Delete. Below this is an 'INFO' section with the following details:

- Created: 07/13/2012
- Uploaded by: Mona Wong
- Views: 4
- Downloads: 4
- Revisions: 3
- Files: 1

The footer of the page reads: 'MIDAS 3.2.6 by Kitware © 2012 - Generated in 0.221 s - Report bug'.

# Share Data with Communities

**iDASH** Search... Upload

Feed  
Explore  
**Communities**  
Users  
My space

RECENTLY VIEWED  
rkd2\_merged\_phase...  
rkd2\_...001.nii.xml

**Kawasaki Disease**  
Repository of de-identified and synthetic Kawasaki Disease (KD) data created for... More »

Data Feed Info Shared with members

| Name                             | Size    | Modified |                                     |
|----------------------------------|---------|----------|-------------------------------------|
| ▼ Private (3)                    | 84.0 MB | 2 days   | <input type="checkbox"/>            |
| ▼ Pediatric (3)                  | 84.0 MB | 2 days   | <input type="checkbox"/>            |
| ▶ rkd1 (0)                       | 0.0 KB  | 2 days   | <input type="checkbox"/>            |
| ▼ rkd2 (3)                       | 84.0 MB | 2 days   | <input type="checkbox"/>            |
| rkd2_merged_phase001.nii         | 84.0 MB | 5 days   | <input checked="" type="checkbox"/> |
| rkd2_merged_phase001.nii.xml     | 15.9 KB | 4 hours  | <input type="checkbox"/>            |
| rkd2_merged_phase001.nii.xml (1) | 0.7 KB  | 1 hour   | <input type="checkbox"/>            |
| ▶ Public (0)                     | 0.0 KB  | 2 days   | <input type="checkbox"/>            |

**ACTIONS**

- Manage
- Send invitation
- Create a top level Folder
- View
- Download latest revision
- Permissions
- Move
- Remove Item from Folder

**SELECTED (1 ELEMENT)**

- Download (1)
- Delete all selected (1)
- Share all selected (1)
- Duplicate all selected (1)
- Annotate image (1)

**INFO**

**rkd2\_merged\_phase001.nii**  
Created 07/09/2012  
Uploaded by Brian Chapman  
Revisions 1  
Files 1  
Size 88080736 B

# Security Features

- Conformant in terms of HIPAA and FISMA for storing PHI/PII
  - LDAP authentication
  - Two Factor authentication
  - Trace Logging
- Permissions are assigned using policies on a per-item and per-folder basis.
- Three states:
  - Own
  - Edit
  - Read
- Things are public when they have anonymous read permissions.



# Use Case - iDash

- Integrating Data for Analysis, Anonymization and SHaring (iDASH)
- Enables global collaborations anywhere and anytime.
- Conformant in terms of HIPAA and FISMA for storing PHI/PII
- One public instance containing anonymized dataset
- One private instance containing Patient-Identifying information

# Use Case - iDash

- Motion sensor data of 16 physical activities (walking, jogging, stair climbing, etc.)
  - <https://idash-data.ucsd.edu/community/7#>
- The CT Colonoscopy project
  - <https://idash-data.ucsd.edu/community/10>

The screenshot displays the iDASH web application interface. At the top, there is a dark header bar with the 'iDASH' logo on the left, a search bar in the center, and a green 'Upload' button on the right. Below the header, the main content area is divided into three sections. On the left is a vertical sidebar with navigation links: 'Feed', 'Explore', 'Communities', 'Users', 'My space', and 'Advanced search'. The central section features the 'CT Colonography' project page. It includes a header with a group icon, the project name, and a brief description: 'Data Description: The CT Colonoscopy project is clinically validating widespread... More ». Below this are three tabs: 'Data', 'Feed', and 'Info', with 'Info' currently selected. The main content of the 'Info' tab is titled 'Data Description:' and contains a paragraph about the project's goal to validate the use of computerized tomographic colonography (CTC) for colorectal neoplasia detection. This is followed by a bulleted list of four project phases: Part I (clinical performance comparison), Part II (CT technique optimization), Part III (lesion detection optimization), and Part IV (patient preferences and cost-effectiveness evaluation). On the right side of the project page, there are two sub-sections: 'MEMBERS' listing 'Brian Chapman' and 'Lucila Ohno-Machado', and 'STATS' showing '2 members'.

**iDASH** Search... Upload

**CT Colonography**  
Data Description: The CT Colonoscopy project is clinically validating widespread... More »

Data Feed Info

### Data Description:

The CT Colonoscopy project is clinically validating widespread use of computerized tomographic colonography (CTC) in screening a population for the detection of colorectal neoplasia. The study addresses aspects of central importance to the clinical application of CTC in several inter-related yet independent parts that will be conducted in parallel.

- In Part I, the clinical performance of the CTC examination will be prospectively compared in a blinded fashion to colonoscopy.
- In Part II, optimization of the CT technique will be performed in view of new technological advances in CT technology.
- In Part III, lesion detection will be optimized by studying the morphologic features of critical lesion types and in the development of a database for computer-assisted diagnosis.
- In Part IV, patient preferences and cost-effectiveness implications of observed performance outcomes will be evaluated using a predictive model.

**MEMBERS**  
Brian Chapman  
Lucila Ohno-Machado

**STATS**  
2 members

# Use Case – 3D Slicer DataStore

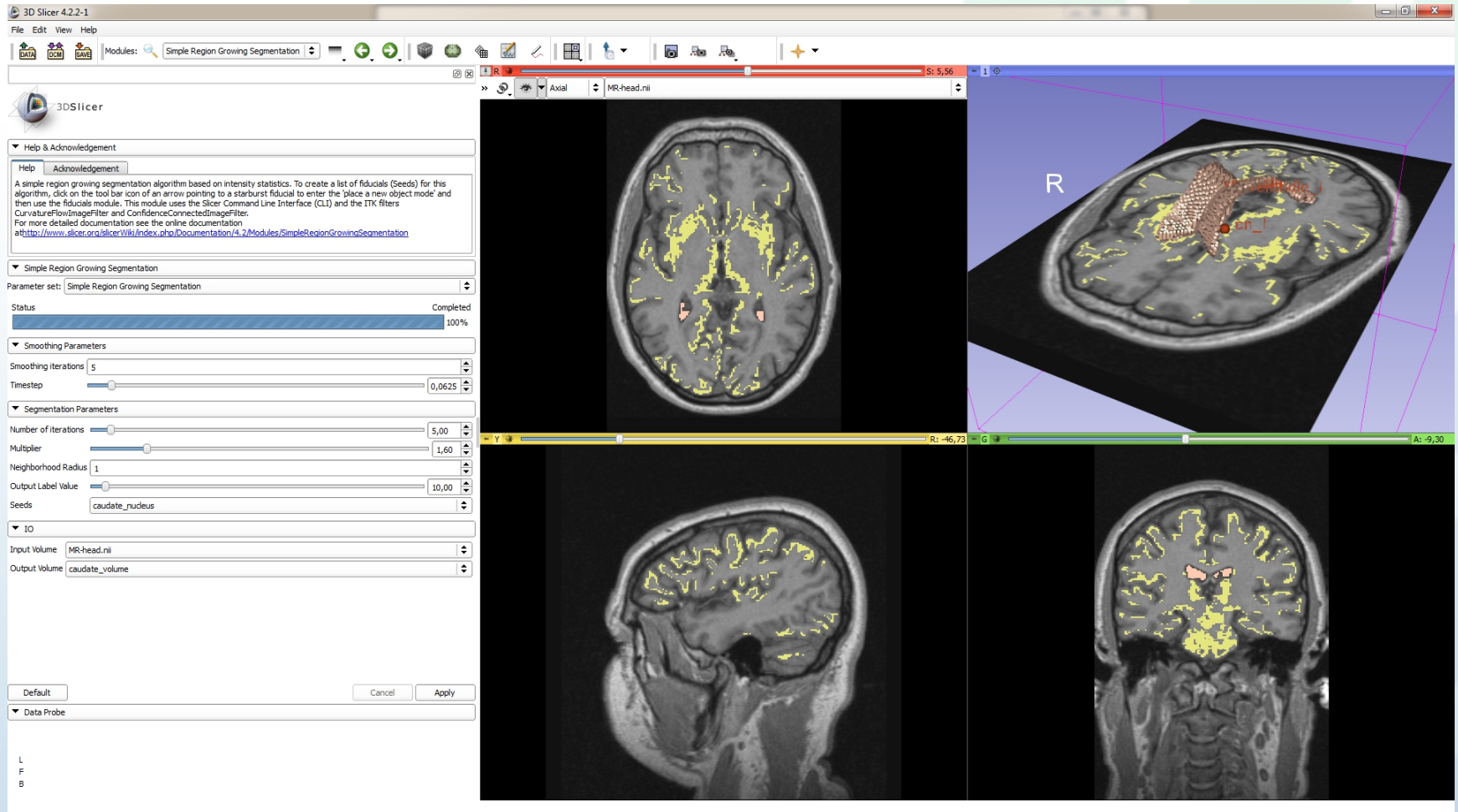
- The Data Store extension allows an user to easily **upload and download dataset** files from **3D Slicer**
- Supports public and private datasets
- Sceneviews are hosted using a MIDAS instance

# What is 3D Slicer?

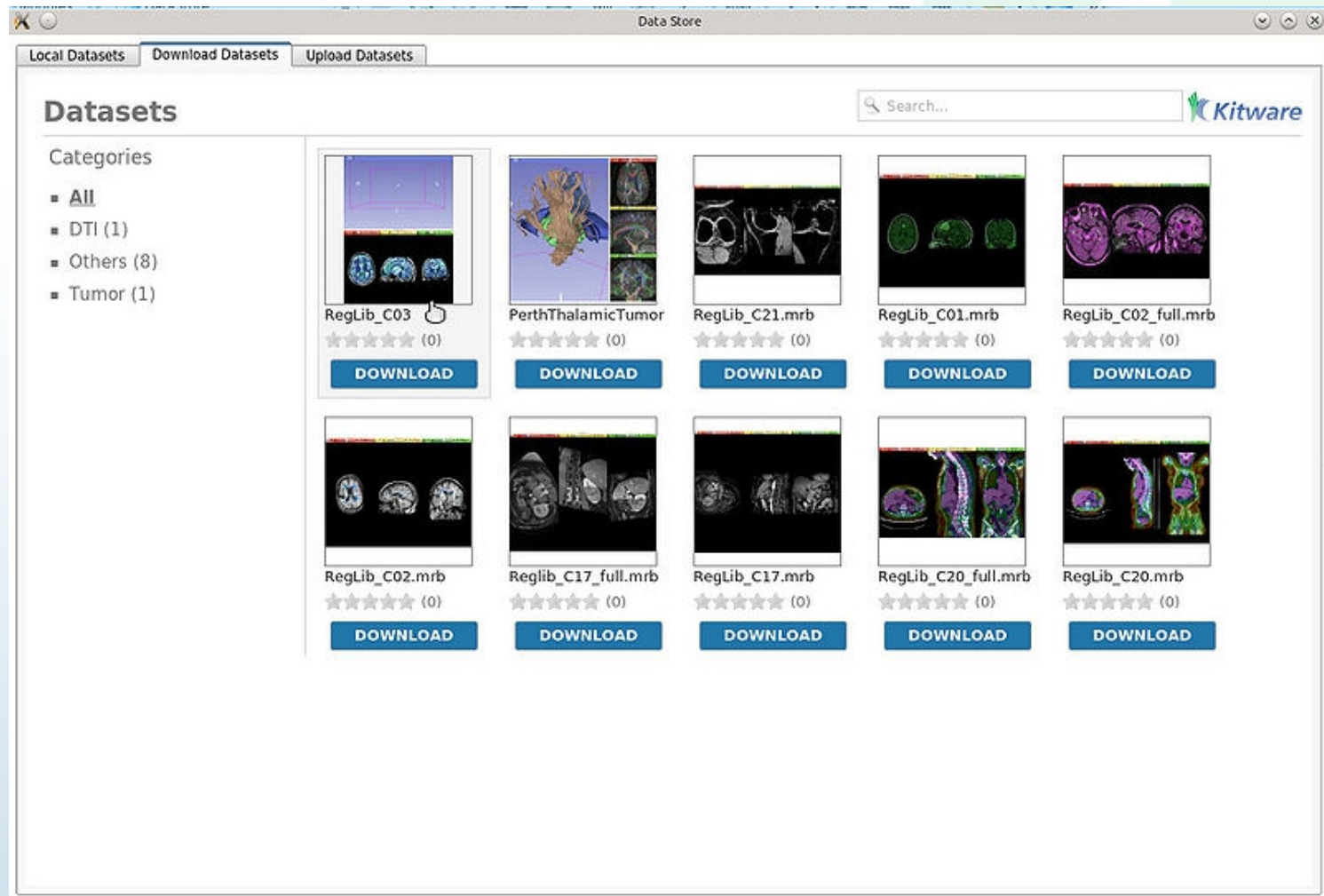
- Visualization and image analysis
- Interactive Segmentation
- Volume Rendering
- Rigid and Nonrigid Registration
- Multiple platforms
  - Windows, OSX, Linux...
- Open source (BSD-like)
  - No restrictions on use



# 3D Slicer - Region Growing



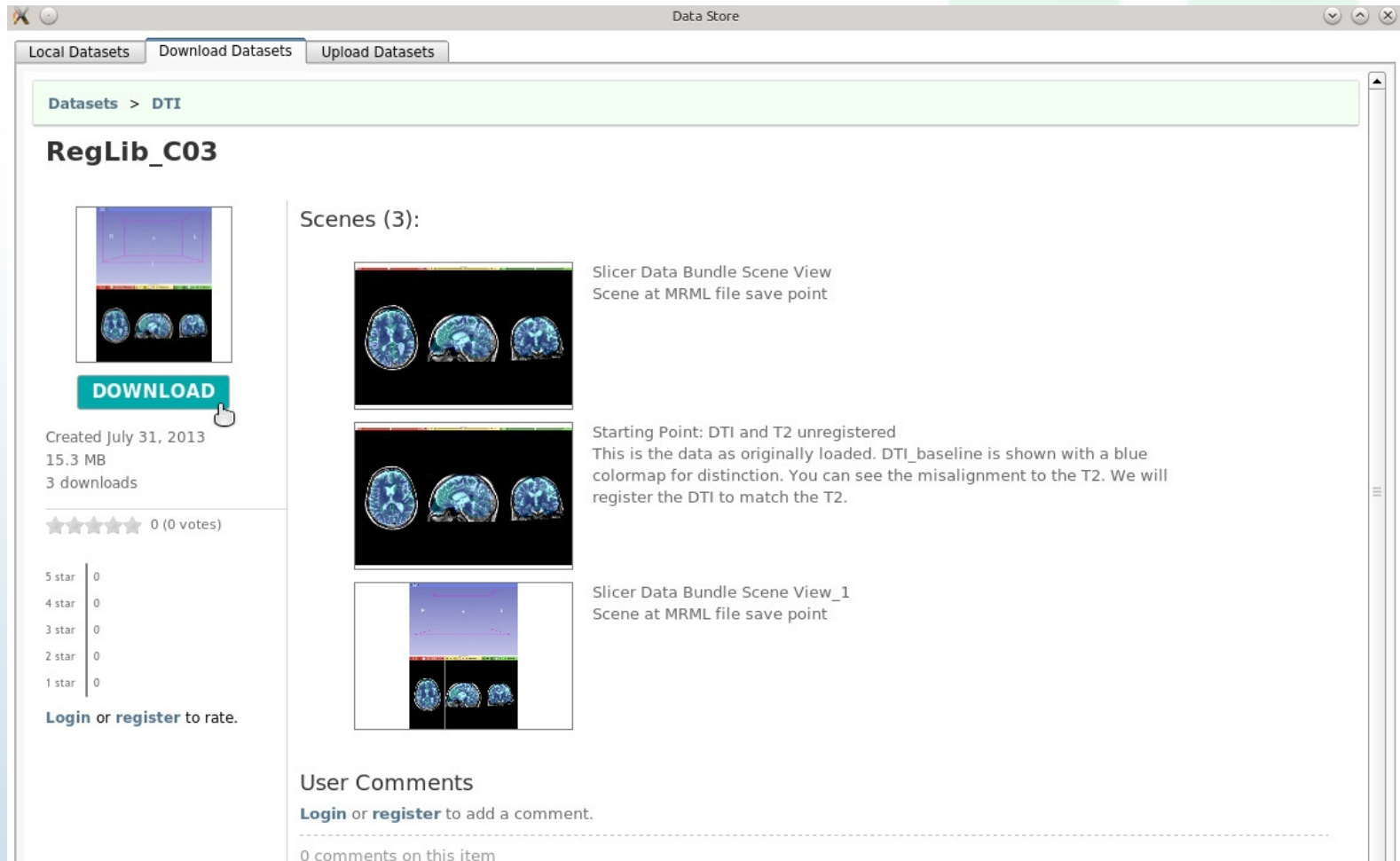
# Use Case - DataStore



<http://slicer.kitware.com/midas3/slicerdatastore>



# Use Case - DataStore



The screenshot displays the Slicer DataStore web application. The browser window title is "Data Store". The navigation bar includes "Local Datasets", "Download Datasets", and "Upload Datasets". The breadcrumb trail is "Datasets > DTI". The dataset title is "RegLib\_C03".

**Dataset Information:**

- Thumbnail:** A small image showing a 3D brain model with a blue wireframe.
- DOWNLOAD:** A green button with a hand cursor.
- Created:** July 31, 2013
- Size:** 15.3 MB
- Downloads:** 3
- Rating:** 0 (0 votes)
- Star Rating:** A list of star ratings from 1 to 5, each with a count of 0.
- Action:** "Login or register to rate."

**Scenes (3):**

- Scene 1:** Slicer Data Bundle Scene View. Scene at MRML file save point. The thumbnail shows three brain slices.
- Scene 2:** Starting Point: DTI and T2 unregistered. This is the data as originally loaded. DTI\_baseline is shown with a blue colormap for distinction. You can see the misalignment to the T2. We will register the DTI to match the T2. The thumbnail shows three brain slices with a blue wireframe.
- Scene 3:** Slicer Data Bundle Scene View\_1. Scene at MRML file save point. The thumbnail shows a 3D brain model with a blue wireframe.

**User Comments:**

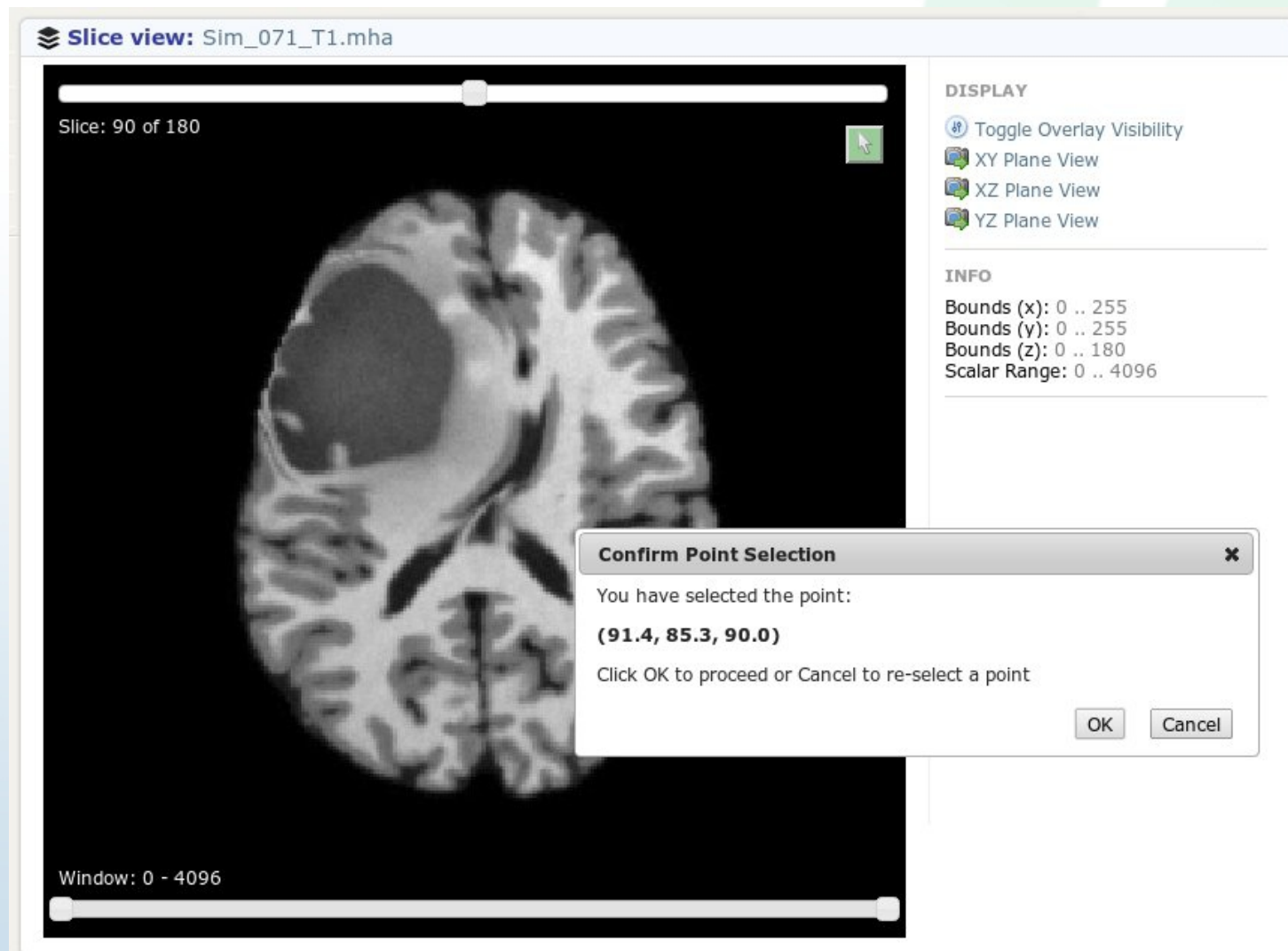
- Action:** "Login or register to add a comment."
- Count:** 0 comments on this item

<http://slicer.kitware.com/midas3/slicerdatastore>

# Use Case - pySlicer

- Provide a medical visualization tool running on every web connected devices (Including Internet explorer and mobile browsers)
- Support for advanced medical visualization technics using a client/server architecture
- Process the datasets online

# Use Case - pySlicer



# Use Case - pySlicer

## Slicer Job Status

**Name:** Slicer Job 58

**Status:** running

**Params:** ["91.448275862069", "85.293103448276", "90"]

**Script:** segmentation

**Creation Date:** 2013-07-10 04:21:40

### Pipeline Progress

| Event         | Message               | Completion Time     |
|---------------|-----------------------|---------------------|
| PipelineStart |                       | 2013-07-10 04:21:55 |
| DownloadInput |                       | 2013-07-10 04:21:55 |
| Process       | Loaded Input Volume   | 2013-07-10 04:22:00 |
| Process       | Starting Segmentation | 2013-07-10 04:22:00 |
| Process       | Finished Segmentation | 000                 |
| Process       | Starting Modelmaker   | 000                 |
| Process       | Finished Modelmaker   | 000                 |
| Process       | Wrote Model Output    | 000                 |
| UploadOutput  |                       | 000                 |
| PipelineEnd   |                       | 000                 |

### Inputs

☐ slice view

☐ volume view

### Outputs

# Resources

- Midas & 3D Slicer
  - <http://midasplatform.org/>
  - <http://www.slicer.org>
  - Tutorials
  - Download
  - User/Developer manual
  - Mailing lists
- iDash Project: <http://idash.ucsd.edu/>
- DataStore: <https://github.com/Slicer/Slicer-DataStore>
- pySlicer: <https://github.com/midasplatform/pyslicer>
- Kitware offers Support and Training



Thank you!

