NCIP Hub, a environment to facilitate scientific collaboration within the Quantitative Imaging Network

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Background of Project

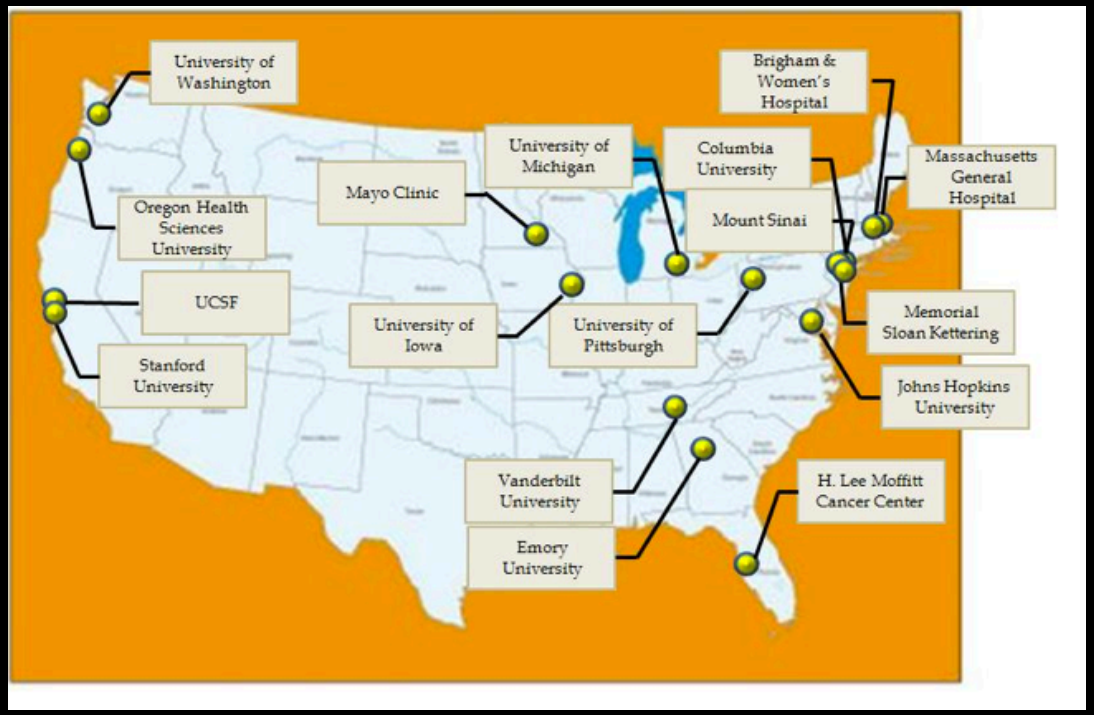
MGH received small, short-term (3 month) contract from CBIIT/SAIC to evaluate utility of NCIP Hub for QIN

- Primary focus on supporting challenges
- Explore other capabilities of HUBzero platform
- Identify advantages as well as potential short term and long term road blocks to using platform in support of QIN

Timing: NCIP Hub being set up at the same time as three pilot "portals"

- No specific training for this project
  - Lots of on-line resources

QIN and QIN working groups



- Data acquisition
- Image Analysis
  - PET/CT
  - DCE/DWI
- Bioinformatics and Data Sharing
- Clinical Trials

Evaluate HUBzero, a platform for scientific collaboration for the QIN network

- HUBzero allows users to deploy computational research software, and visualize and analyze results, all through a web browser
- Eases the task of accessing high-performance and cloud computing systems.
- Facilitates cloud computing
  - Algorithm comparison/challenges
- Developing a community
  - Built-in social networking features create communities in almost any field and facilitate communication and collaboration, distribution of research results, training, and education.

HUBzero core capabilities

- Marketplace/Catalog: Sharing QIN research outputs (including interim ones), create catalog of resources
- AppStore: Share QIN tools, enable others' use of the tools etc.
- Collaboratory: Develop tools together, Gather input on use of tools and other communication for network/group activities etc.

NCIP Hub could facilitate…

- Communication
  - Wikis, blogs, social media features, calendars
- QIN (and other) challenges
- Tool sharing
  - Metrology tools
  - Image analysis tools
- Cloud computing
  - Bring algorithms to data
- Development of collaborative image analysis tools/pipelines
  - Leverage expertise from different sites

Communication

NCIP | HUB | A Community Portal for Cancer Informatics

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DISCOVER | COMMUNITY | ABOUT | SUPPORT | Enter a keyword or phrase

Home / Groups / Quantitative Imaging Network (QIN)

Group Manager

- Overview
- Members 14
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- Resources 2
- Discussion
- Blog
- Wish List 1
- Projects
- Calendar
- Announcements

Quantitative Imaging Network (QIN) ▸ Overview

image-guided | Imaging | interventions | measurements | methods | Network | Quantitative | software

ABOUT THE GROUP

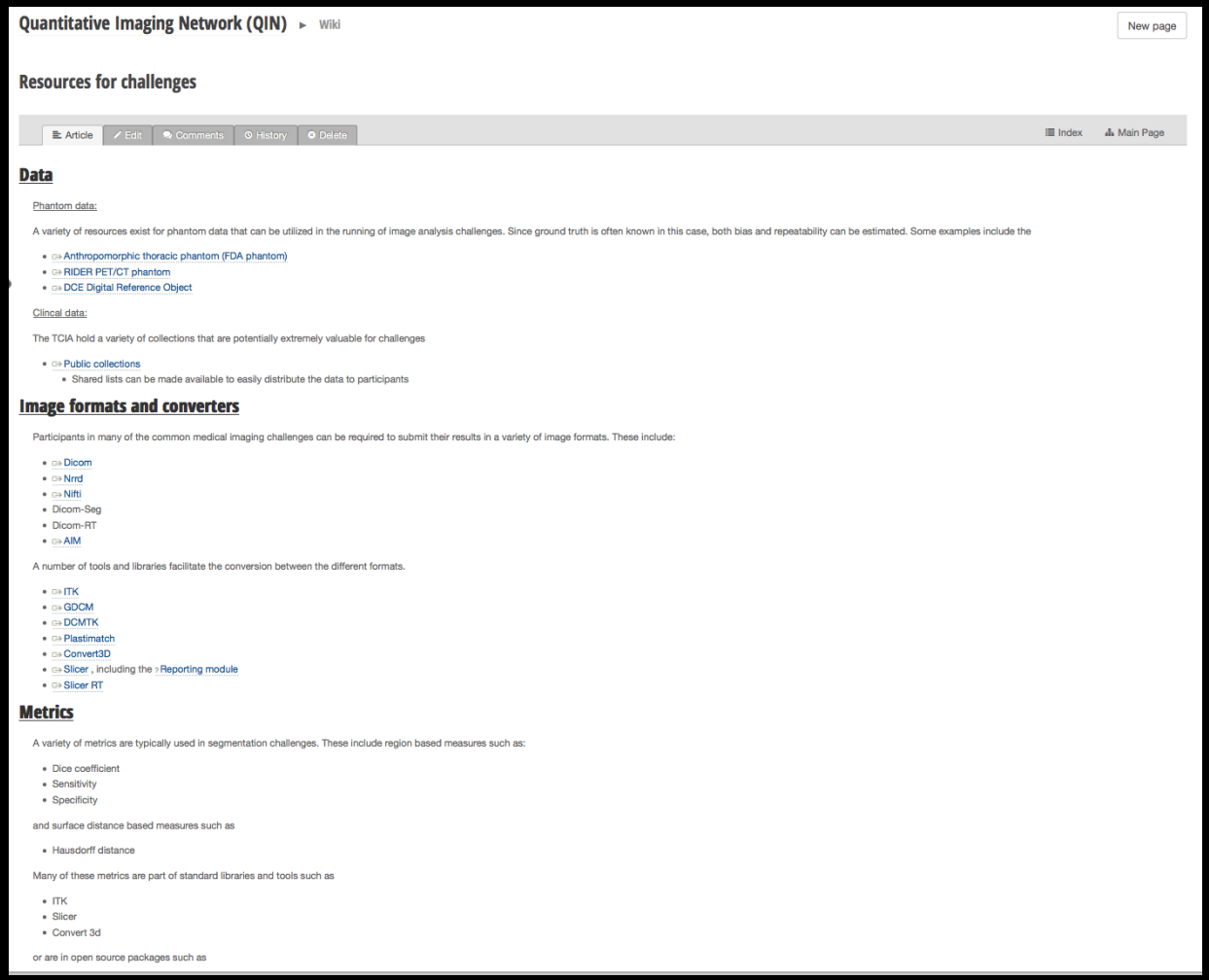
The Quantitative Imaging Network (QIN) is one of several within the Cancer Imaging Program. It is designed to promote research and development of quantitative imaging methods for the measurement of tumor response to therapies in clinical trial settings, with the overall goal of facilitating clinical decision making. The main emphasis is on the support of the development and adaptation/implementation of quantitative imaging endpoints (including imaging methods and related software tools research, and/or informatics infrastructure, as needed). Projects include the appropriate development and adaptation/implementation of quantitative imaging methods, imaging protocols, and software solutions/tools (using existing commercial imaging platforms and instrumentation) and application of these methods in current and planned clinical therapy trials. The projects are focusing on imaging-derived quantitative measurements of responses to drugs and/or radiation therapy, and/or image-guided interventions (IGI).

To date, sixteen centers of imaging excellence have been selected through the NIH peer review process and more will be added as they pass through peer review. Five working groups, addressing common issues to the various programs, including data collection, image analysis, informatics, clinical trial design, and network outreach have been established. These working groups are composed of members of the different QIN teams, though not necessarily the principal investigators. The Network's Steering Committee meets monthly via teleconference and organizes network-wide activities such as consensus publications, cross-network activities, associate membership in the network, and semi-annual face-to-face meetings. To achieve the goals of the QIN, multidisciplinary teams that include oncologists as well as clinical and basic imaging scientists are required. The involvement of industrial partners in the development and adaptation/implementation of quantitative imaging methods to aid cancer therapies is encouraged.

GROUP MEMBERS

View All Members →

Sharing list of resources



Quantitative Imaging Network (QIN) ▸ Wiki

New page

Resources for challenges

Article | Edit | Comments | History | Delete | Index | Main Page

Data

Phantom data:

A variety of resources exist for phantom data that can be utilized in the running of image analysis challenges. Since ground truth is often known in this case, both bias and repeatability can be estimated. Some examples include the

- Anthropomorphic thoracic phantom (FDA phantom)
- RIDER PET/CT phantom
- DCE Digital Reference Object

Clincal data:

The TCIA hold a variety of collections that are potentially extremely valuable for challenges

- Public collections
  - Shared lists can be made available to easily distribute the data to participants

Image formats and converters

Participants in many of the common medical imaging challenges can be required to submit their results in a variety of image formats. These include:

- Dicom
- Nrrd
- Nifti
- Dicom-Seg
- Dicom-RT
- AIM

A number of tools and libraries facilitate the conversion between the different formats.

- ITK
- GDCM
- DCMTK
- Plastimatch
- Convert3D
- Slicer , including the ? Reporting module
- Slicer RT

Metrics

A variety of metrics are typically used in segmentation challenges. These include region based measures such as:

- Dice coefficient
- Sensitivity
- Specificity

and surface distance based measures such as

- Hausdorff distance

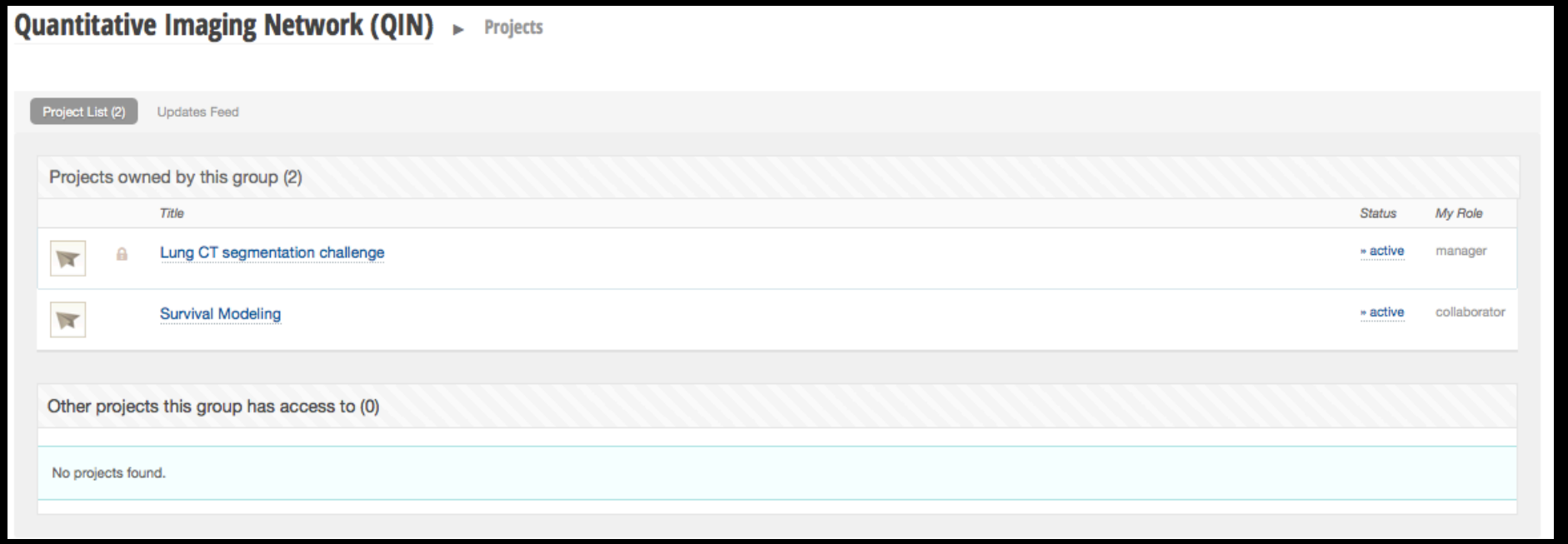
Many of these metrics are part of standard libraries and tools such as

- ITK
- Slicer
- Convert 3d

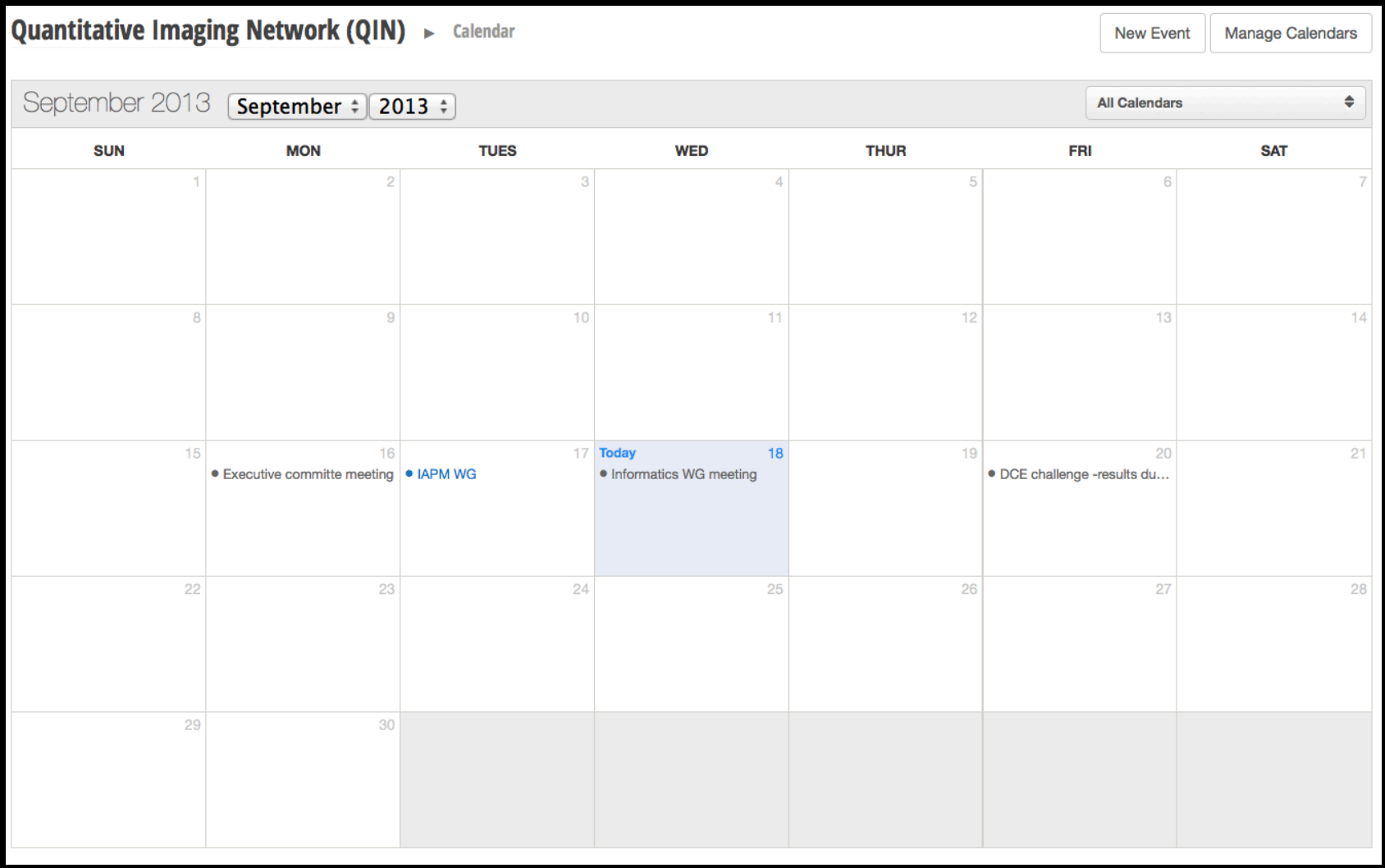
or are in open source packages such as

http://nciphub.org/groups/qinportal/wiki/MainPage/Resourcesforchallenges

Projects


Quantitative Imaging Network (QIN) ▸ Projects
Project List (2)
Updates Feed
Projects owned by this group (2)
Title
Status
My Role
Lung CT segmentation challenge
» active
manager
Survival Modeling
» active
collaborator
Other projects this group has access to (0)
No projects found.

Calendar


Quantitative Imaging Network (QIN) ▸ Calendar
New Event
Manage Calendars
September 2013
September
2013
All Calendars
SUN
MON
TUES
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THUR
FRI
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IAPM WG
Today
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Informatics WG meeting
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DCE challenge -results du…
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Sharing resources (access controlled)

- Presentations
- Manuscripts
- Data
- Code snippets

http://nciphub.org/resources/33

Resources: New

Main page

Downloads

Spreadsheets, executables, and other items that are available for download but don't fit into other categories.

Publications

Articles, technical reports, theses, and other documents, usually in PDF or DOC format.

Seminars

A lecture of some sort, usually recorded with voice or video. It may be a graduate or undergraduate level seminar, a lecture for a class, or a tutorial presentation.

Teaching Materials

Supplementary materials (study notes, guides, etc.) that don't quite fit into any of the other categories.

Tools

Simulation and modeling tools that can be accessed via a web browser.

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Select a type

Select one of the resource types listed to proceed to the next step. The type of resource chosen can affect what information you will need to provide in the following steps.

Facilitating Quantitative Image Analysis Algorithm Comparisons within the Quantitative Imaging Network (QIN)

Overall goals

- Evaluate the performance of quantitative imaging biomarkers, image analysis algorithms and novel techniques by facilitating the direct comparison of results utilizing
  - Common datasets with a wide range of lesions (size, shape, texture, location)
  - Statistical analysis
  - Established metrics
- Encourage participation by leading imaging centers within the network and larger community

Lung CT segmentation challenge

Goal: Performance Evaluation of Lung Lesion Segmentation Algorithms

Dataset: 52 lesions from 5 collections (TCIA)

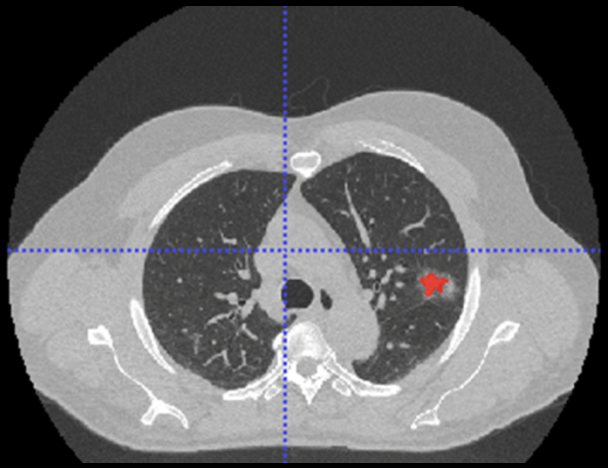
> CUMC (phtantom with known volumes), LIDC, RIDER, Moffitt, Stanford

Participants: Members of QIN

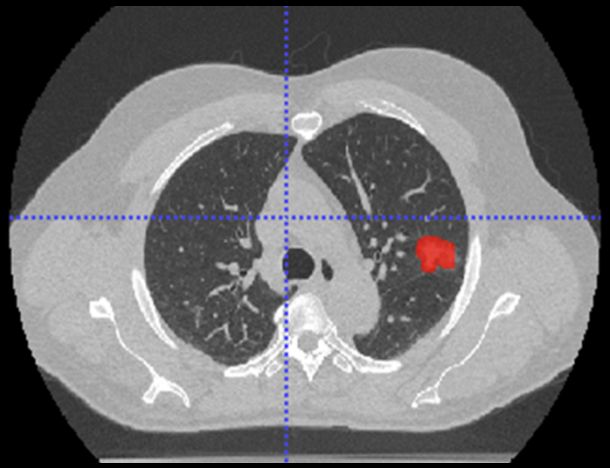
Submissions: Each site submitted 3 runs for each lesion,

Evaluations: bias and reproducibility of volumes, overlap metrics

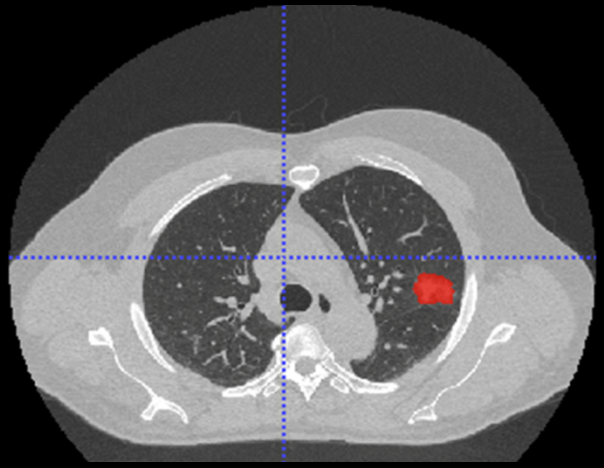
Sample Results (4 algorithms)



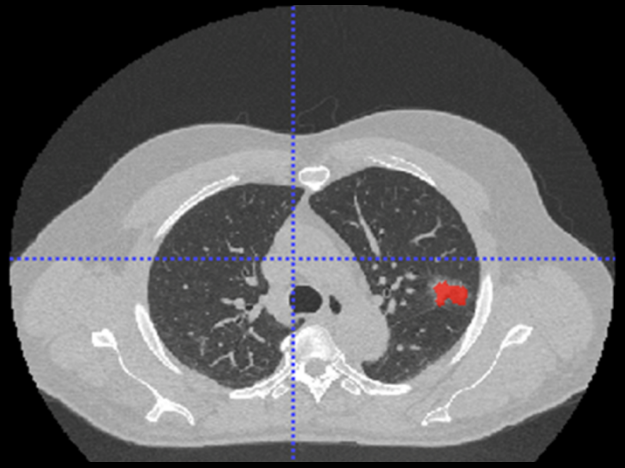
Single Click



Seed Circle



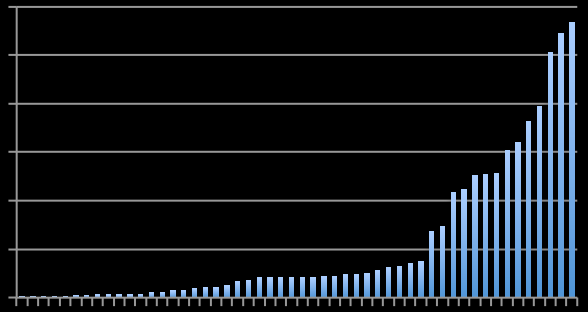
Watershed Active Contour



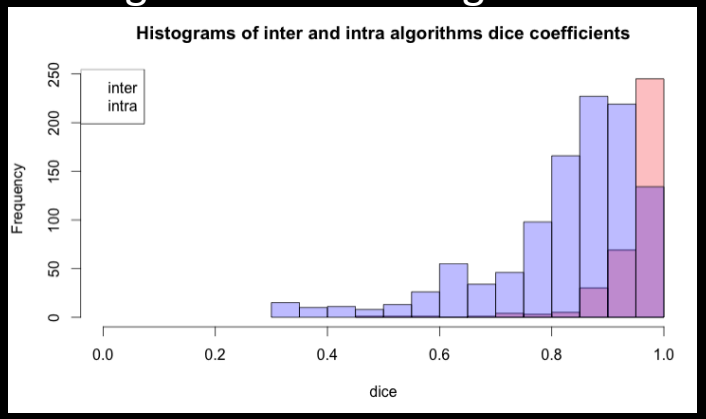
Level Set

Example results

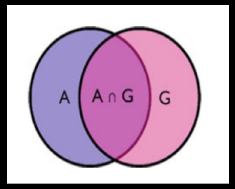
Wide range of volumes of lesions being evaluated



Intra algorithm volume overlap higher than inter algorithm

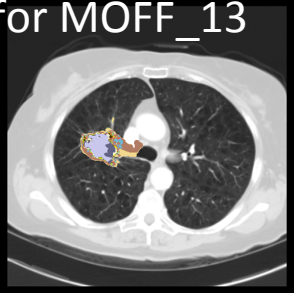


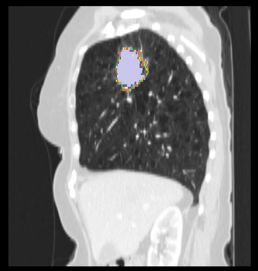
Dice coefficient

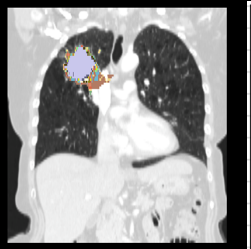


$$D = \frac{2|A \cap G|}{|A| + |G|} \times 100$$

Map displaying areas of high (light purple) and low agreement (brown) between algorithms for MOFF_13







Pairwise dice coefficients (overlap between results of different algorithms)

Dice (FDA_0011)	Alg_1_1	Alg_1_2	Alg_2_1	Alg_2_3	Alg_3_1	Alg_3_2	Alg_4_1	Alg_4_2	Alg_5_1	Alg_5_2	Alg_5_3
Alg_1_1	1.00	0.97	0.83	0.83	0.88	0.88	0.88	0.88	0.88	0.88	0.89
Alg_1_2	0.97	1.00	0.81	0.81	0.87	0.87	0.87	0.87	0.88	0.88	0.89
Alg_2_1	0.83	0.81	1.00	1.00	0.88	0.88	0.86	0.87	0.78	0.78	0.78
Alg_2_3	0.83	0.81	1.00	1.00	0.88	0.88	0.86	0.87	0.78	0.78	0.78
Alg_3_1	0.88	0.87	0.88	0.88	1.00	0.99	0.94	0.95	0.86	0.86	0.86
Alg_3_2	0.88	0.87	0.88	0.88	0.99	1.00	0.93	0.95	0.86	0.86	0.86
Alg_4_1	0.88	0.87	0.86	0.86	0.94	0.93	1.00	0.96	0.85	0.85	0.85
Alg_4_2	0.88	0.87	0.87	0.87	0.95	0.95	0.96	1.00	0.85	0.85	0.85
Alg_5_1	0.88	0.88	0.78	0.78	0.86	0.86	0.85	0.85	1.00	0.99	0.99
Alg_5_2	0.88	0.88	0.78	0.78	0.86	0.86	0.85	0.85	0.99	1.00	0.99
Alg_5_3	0.89	0.89	0.78	0.78	0.86	0.86	0.85	0.85	0.99	0.99	1.00

C3D Driver

File

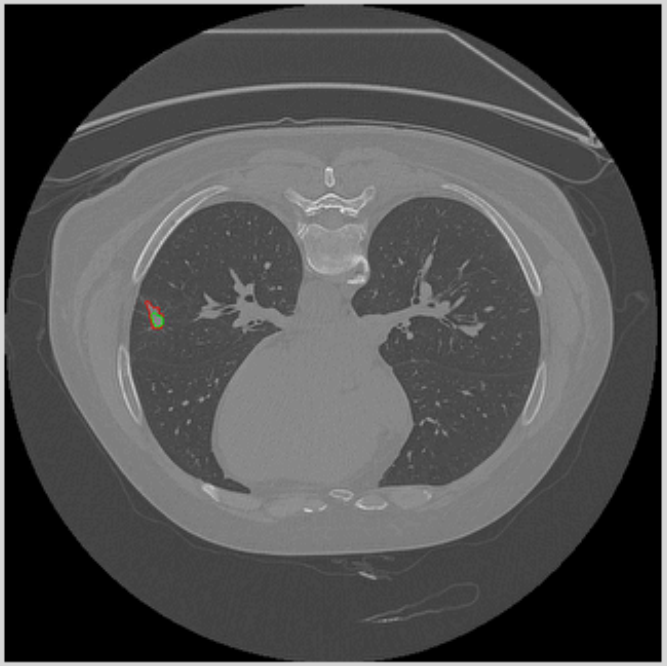
Instructions goes here that tells the user what to do and expect.

Simulate

Result: Base Image

```
/apps/share64/debian7/convert3d/nightly/bin/c3d -verbose /home/nci
Dice similarity coefficient:     0.978089

/apps/share64/debian7/convert3d/nightly/bin/c3d -verbose /home/nci
Dice similarity coefficient:     0.826416
```



Base Image: stan 0

Upload Identifier: stan1

Compare To: cumc1

Slice = 140

Options...

1 result Clear

DCE-MRI challenge

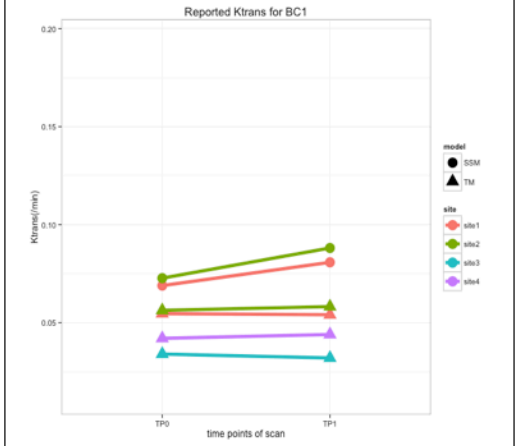
Goal: Multi-QIN sites DCE-MRI Data Analysis Challenge to evaluate the ability of DCE analysis software packages/models to distinguish pathologic responders from non-responders after 1 cycle of chemotherapy

Dataset: 20 studies (10 patients at baseline and after 1 cycle of chemotherapy)

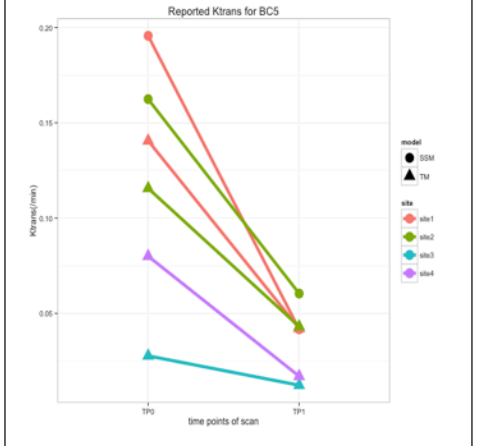
Participants: Members of QIN

Evaluations: ability of models to predict response seen in pathology based on changes in Ktrans

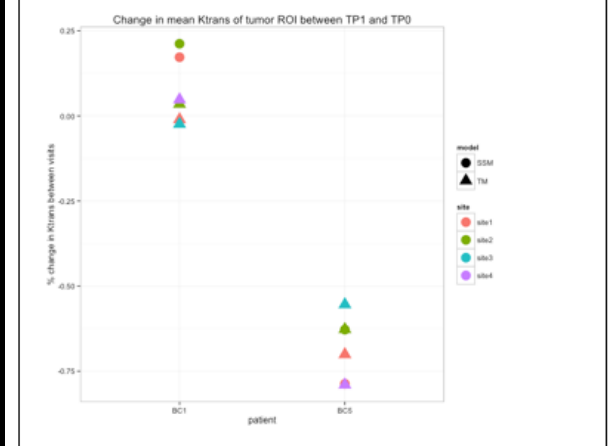
DCE-challenge results (preliminary)



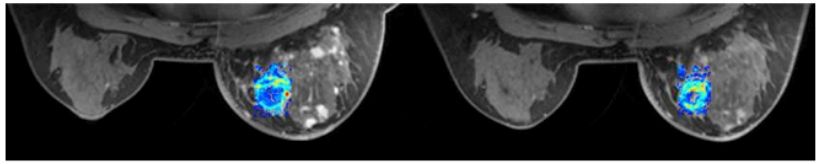
Reported Ktrans values for BC1 for TP0 (baseline) and TP1 (after 1 chemo cycle)



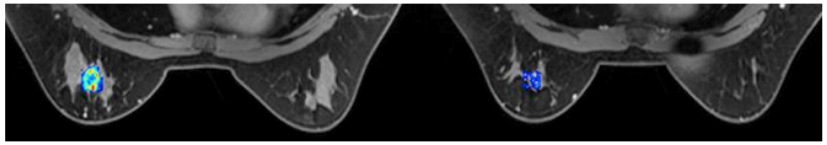
Reported Ktrans values for BC5 for TP0 (baseline) and TP1 (after 1 chemo cycle)



Percent change in Ktrans between visits, for the different DCE-MRI models



Example parametric maps displaying Ktrans at TP0 and TP1 for BC1 (pathological partial responder)

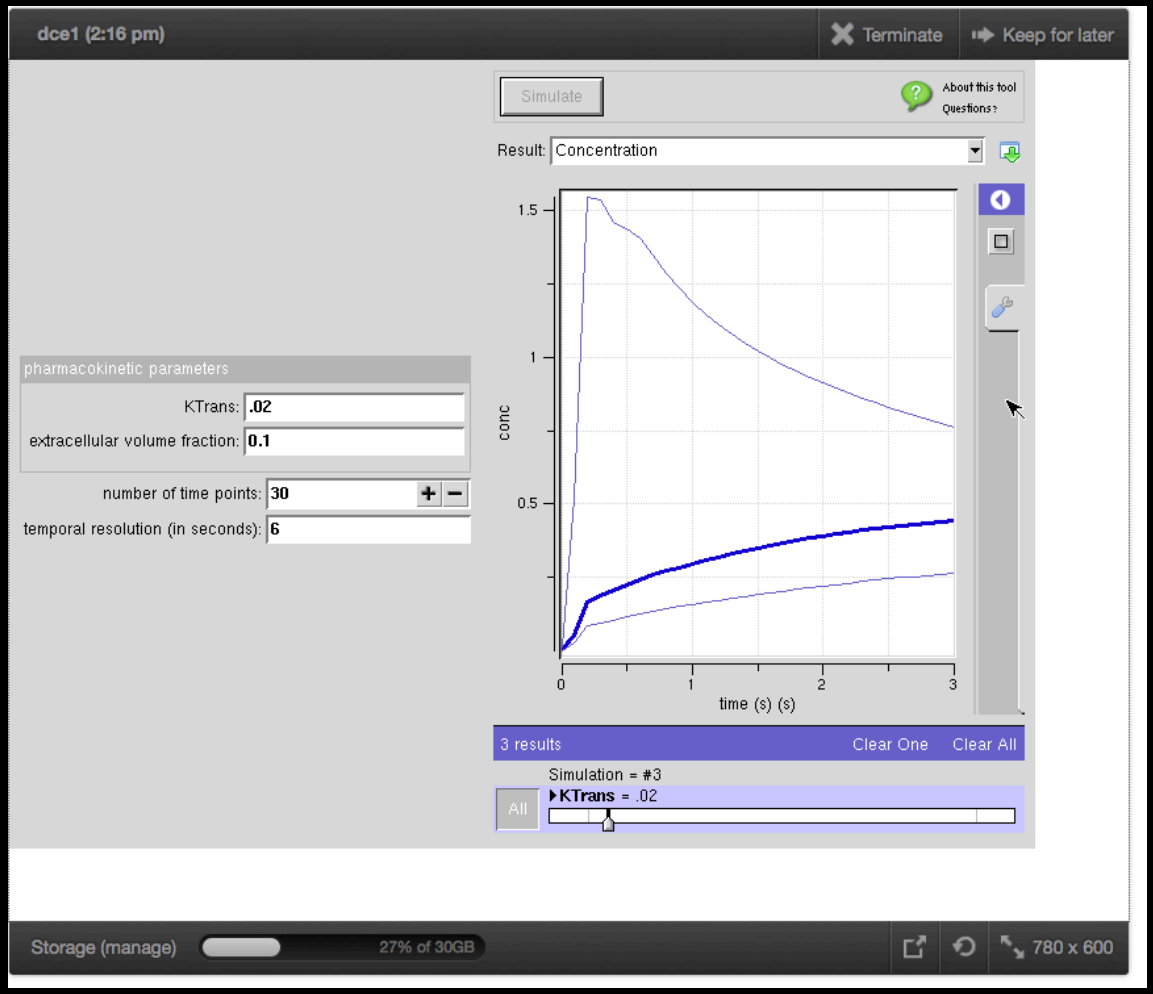


Example parametric maps displaying Ktrans at TP0 and TP1 for BC5 (pathological complete responder. A substantial change is seen at the second visit, suggesting a response to therapy

DCE-DRO challenge

- Digital reference object
  - Software phantom

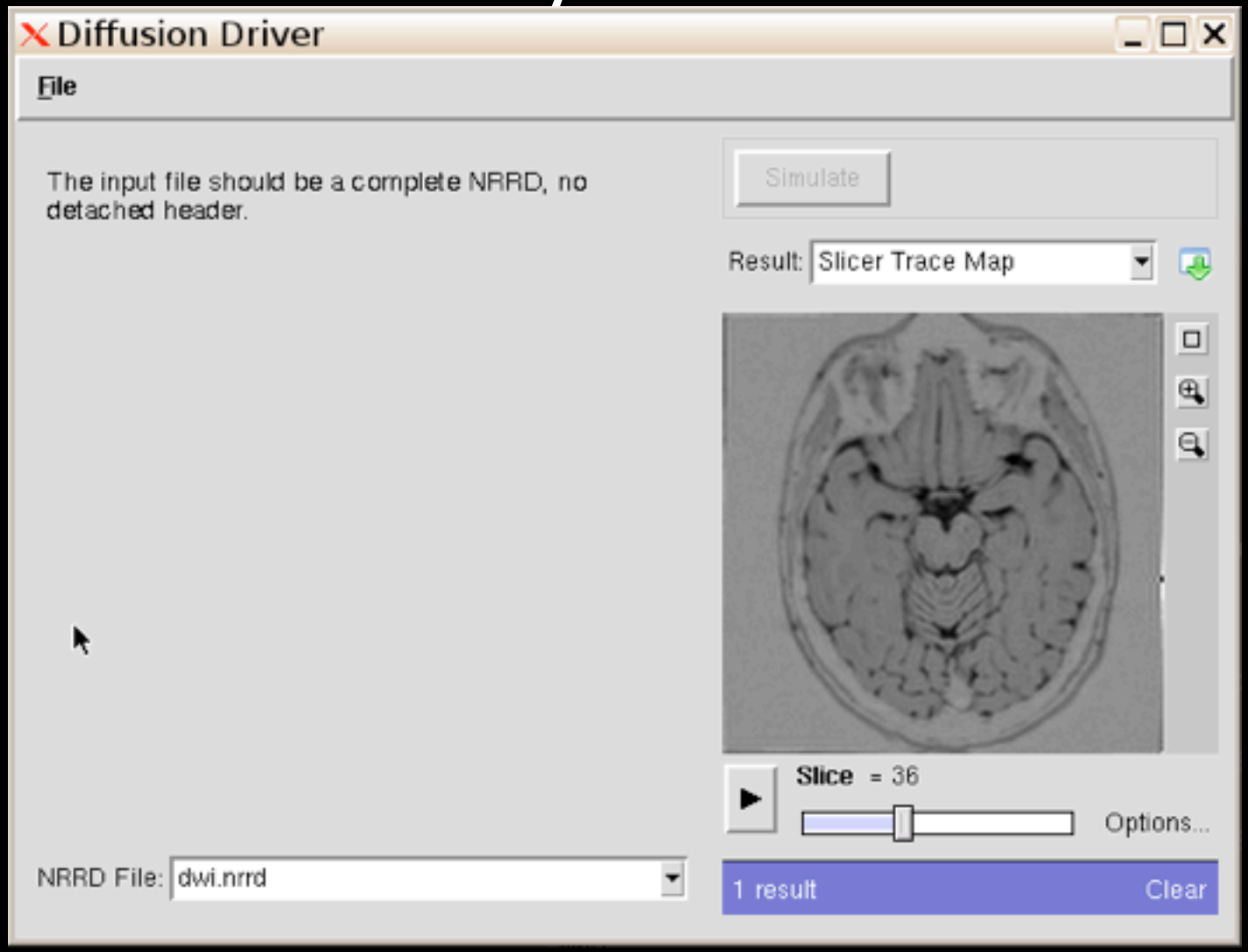
Demo- DCE simulation



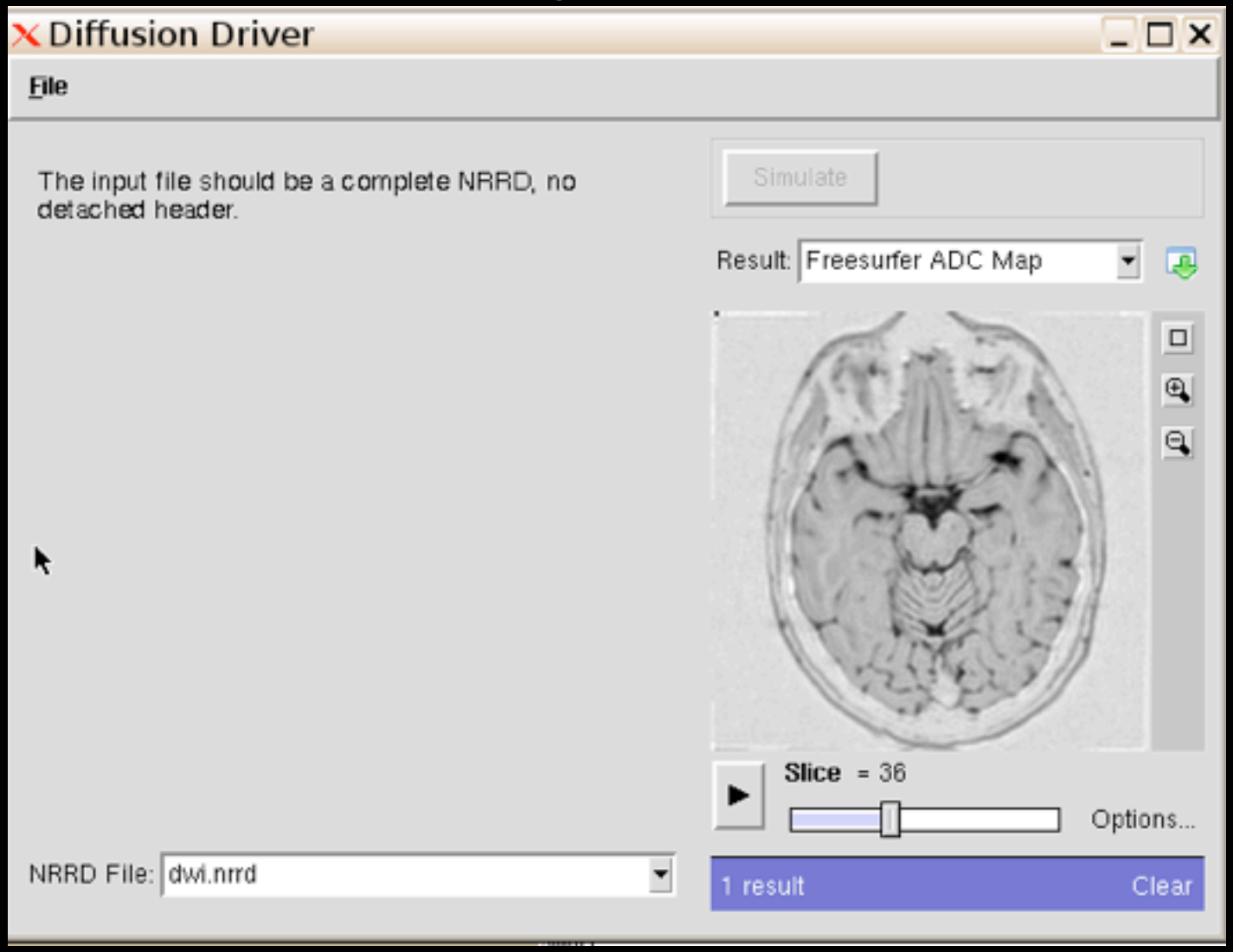
Tool sharing

- Metrology tools
  - Best statistical methods for algorithm comparison
    - Test-retest
    - Agreement
    - Inter-rater agreement
  - Best approaches for evaluating segmentation, registration
- Image analysis tools
  - Open source tools (Slicer, Freesurfer etc)
  - Matlab scripts
  - Python scripts (glue)

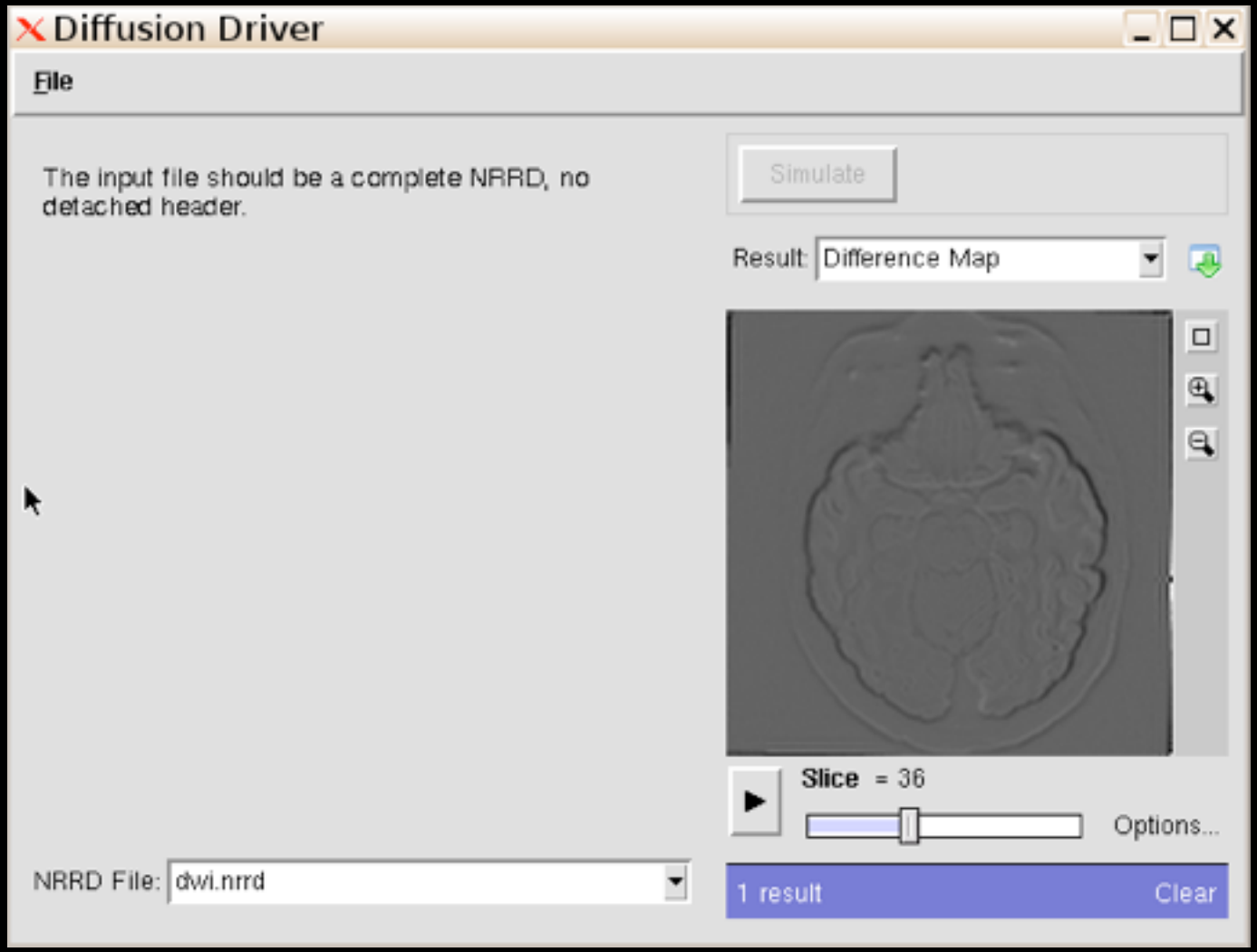
Demo-wrapping Slicer's Diffusion analysis tool



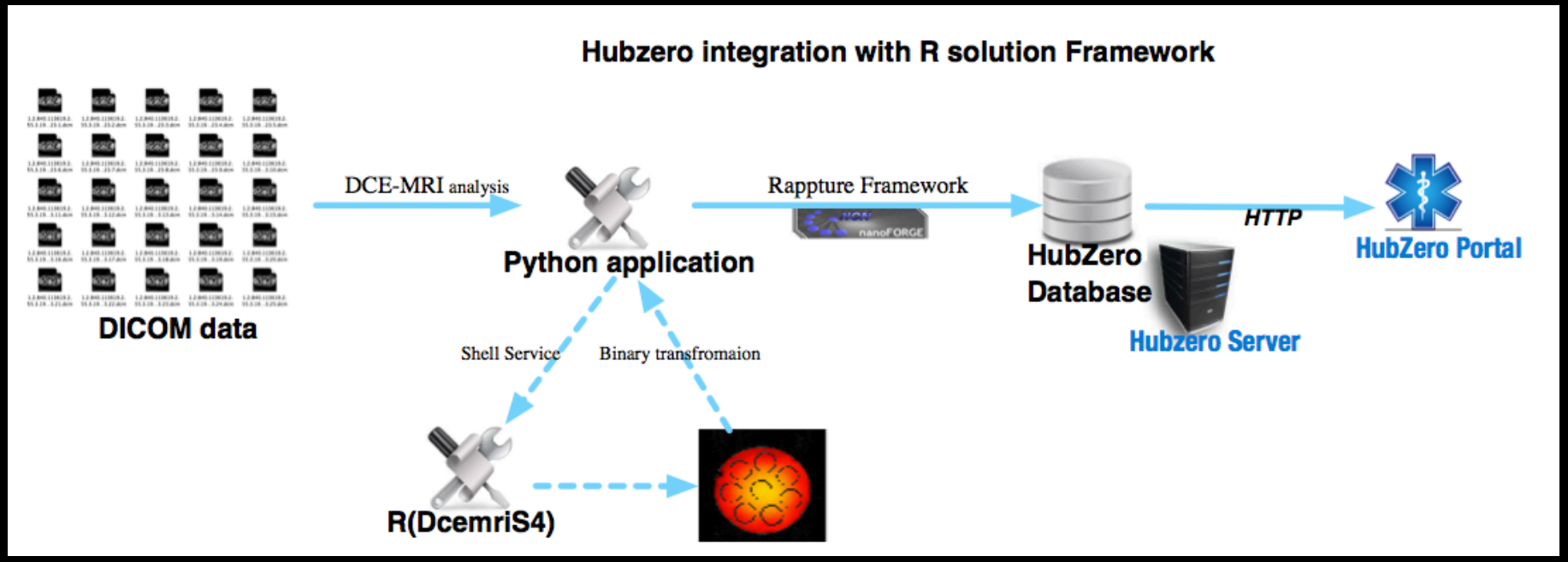
Demo-wrapping Freesurfer's Diffusion analysis tool



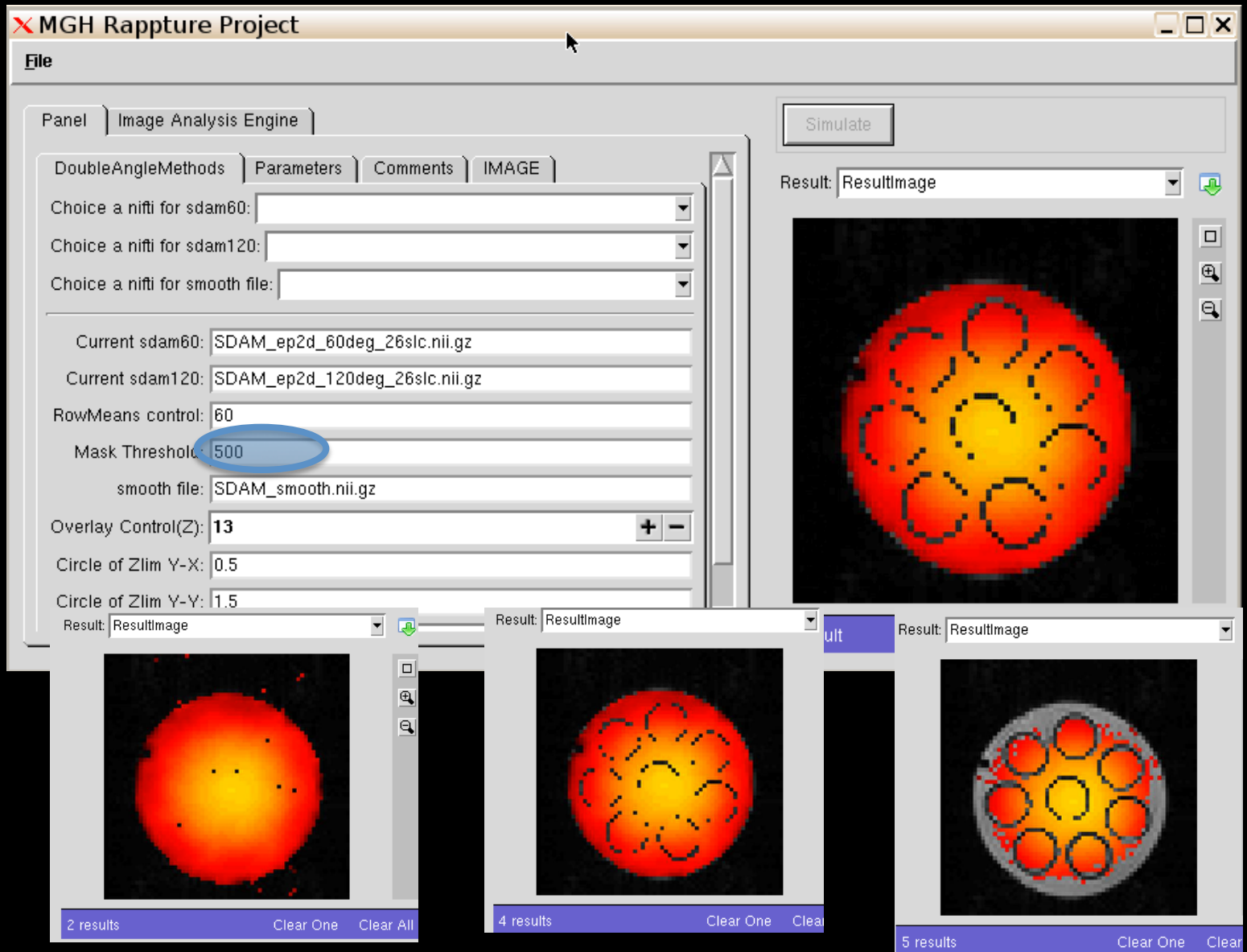
Difference Map



Hubzero/Rappture integration with R



Demo-wrapping R package for B1 map calculation



Cloud computing

- Bring algorithms to data
  - Share data in common location
    - “groups”?
  - Run algorithms in Hub environment
  - Results in Hub

Collaborative pipelines

- String together tools created by different groups
  - Select “best modules”

QIN portal for nciphub

- Share (open source) tools for image analysis
- Develop and deploy statistical analysis and metrology tools
- Develop a community of quantitative imaging researchers
- Share data including software phantoms
- Perform algorithm comparisons
- Make recommendations for best practices

Going forward

- Native DICOM viewers
  - Better medical image display and handling is needed within Rappture
- A way to bypass the user workspace and transfer data directly to the group /data folder
- Data sharing options for large imaging datasets need to be improved
- Direct connection with TCIA
- Support for relational databases (sqlite or postgres) would be necessary for a number of the tasks of the QIN groups

Going forward

- Interactive tools
- Support for Github might be important as a number of the open-source projects within the QIN are hosted on github
- Need to identify an optimal method to share code snippets (similar to gist on github)
- Need to incorporate workflow tools such as the Pegasus system
- Ability for users to upload data and have databases updated to reflect that would be useful