

**3D Slicer
for clinical use,
for radiotherapy research,
and for your research work**

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3D Slicer for clinical use

software application for MRI-guided prostate interventions



MRI-guided prostate biopsy

Multiple supported devices

- Transrectal robot-assisted (TRR) →
- Transperineal template (TPT) →
- Transperineal robot-assisted (TPR) →



Multiple clinical sites

- NIH-NCI (Bethesda, MD): TRR
- JHH (Baltimore, MD): TRR
- BWH (Boston, MA): TPT, TPR
- PMH (Toronto, ON): image sharing only

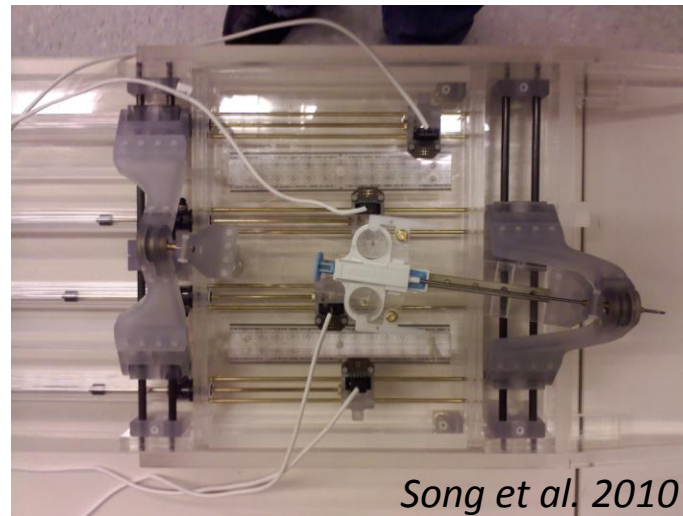
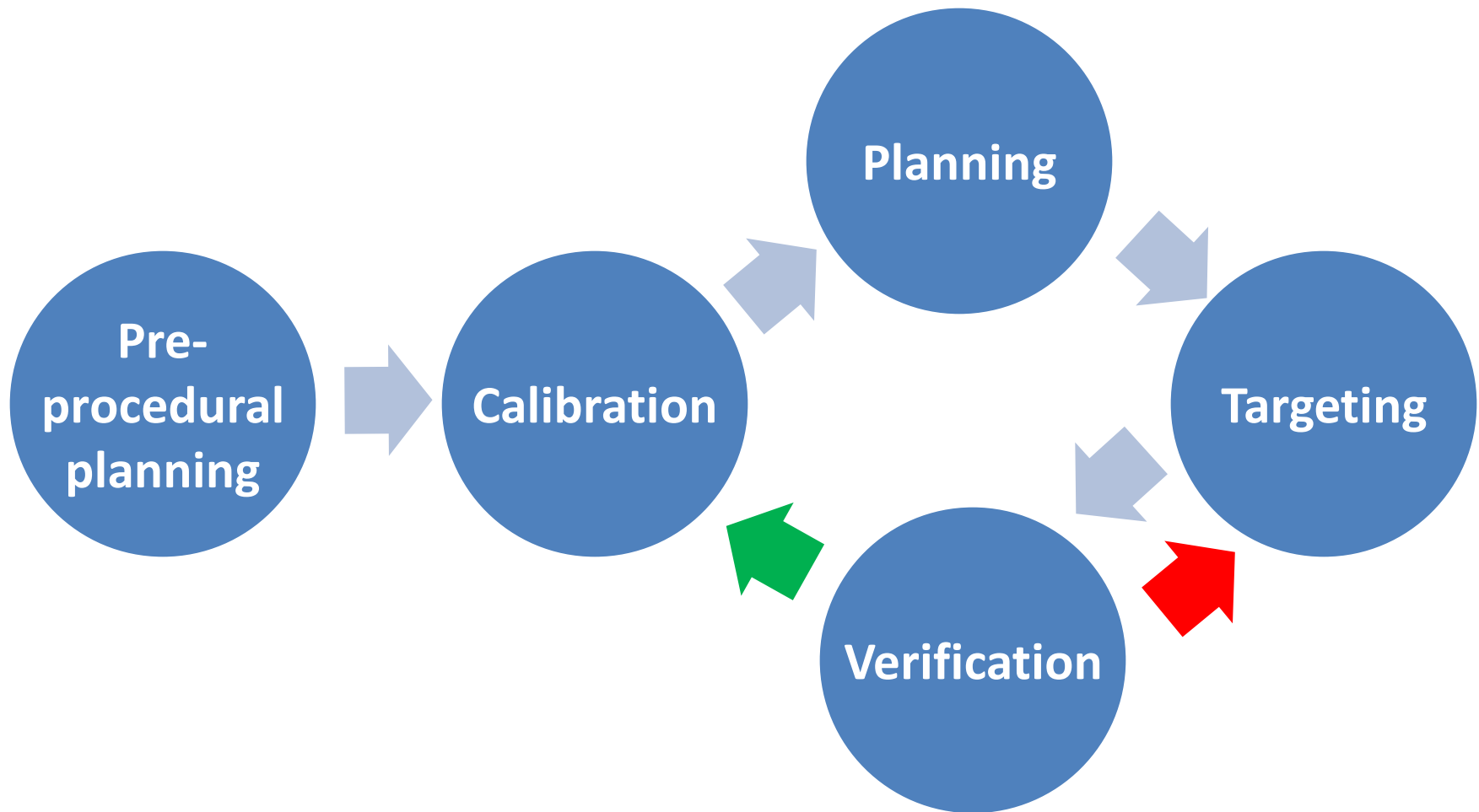
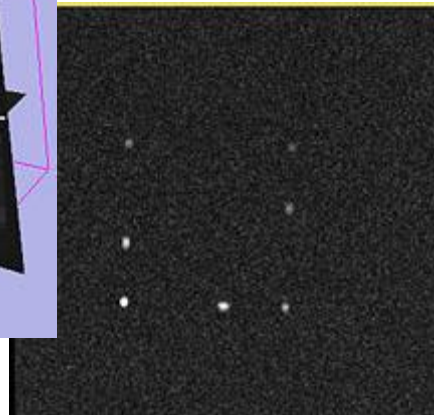
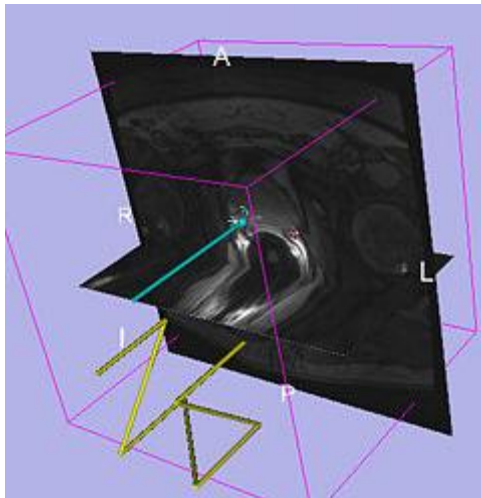
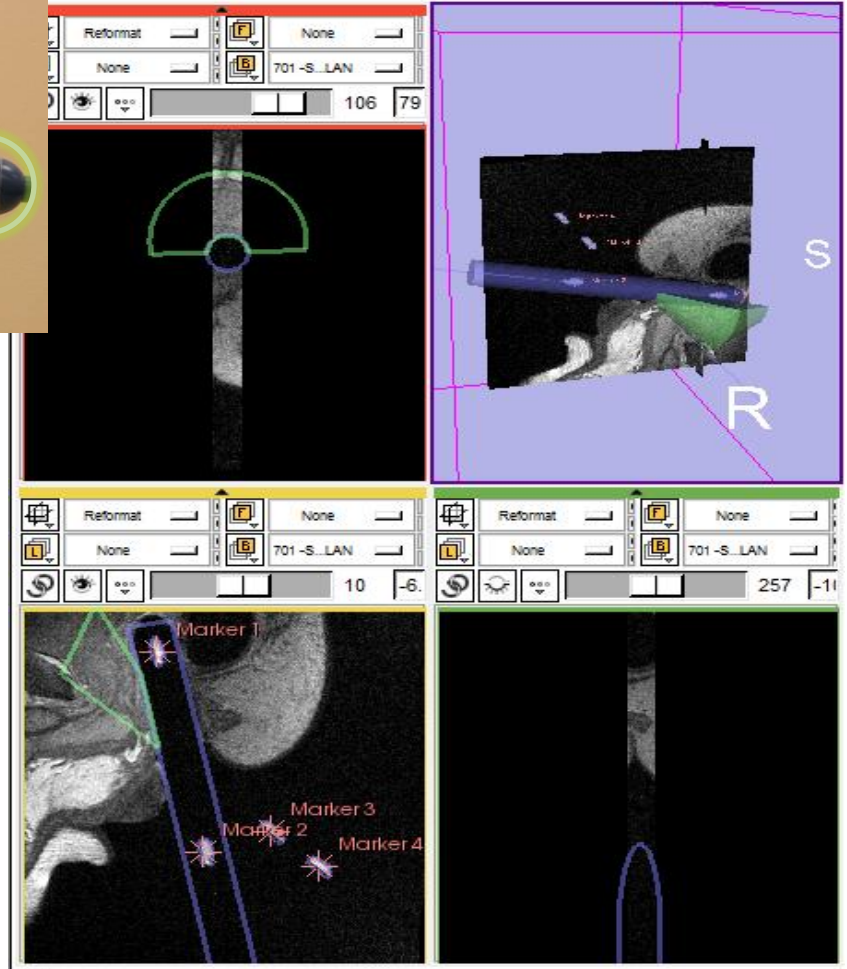
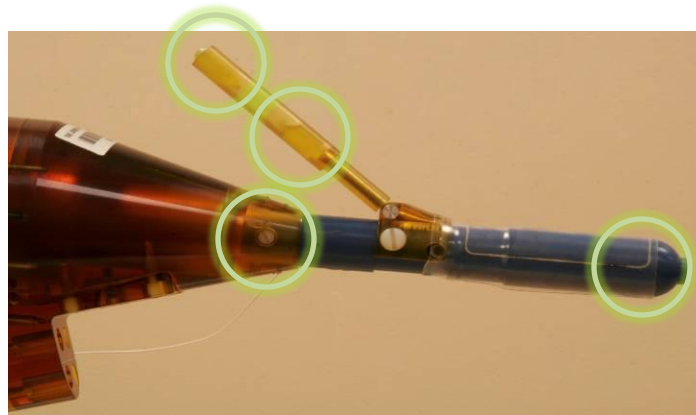


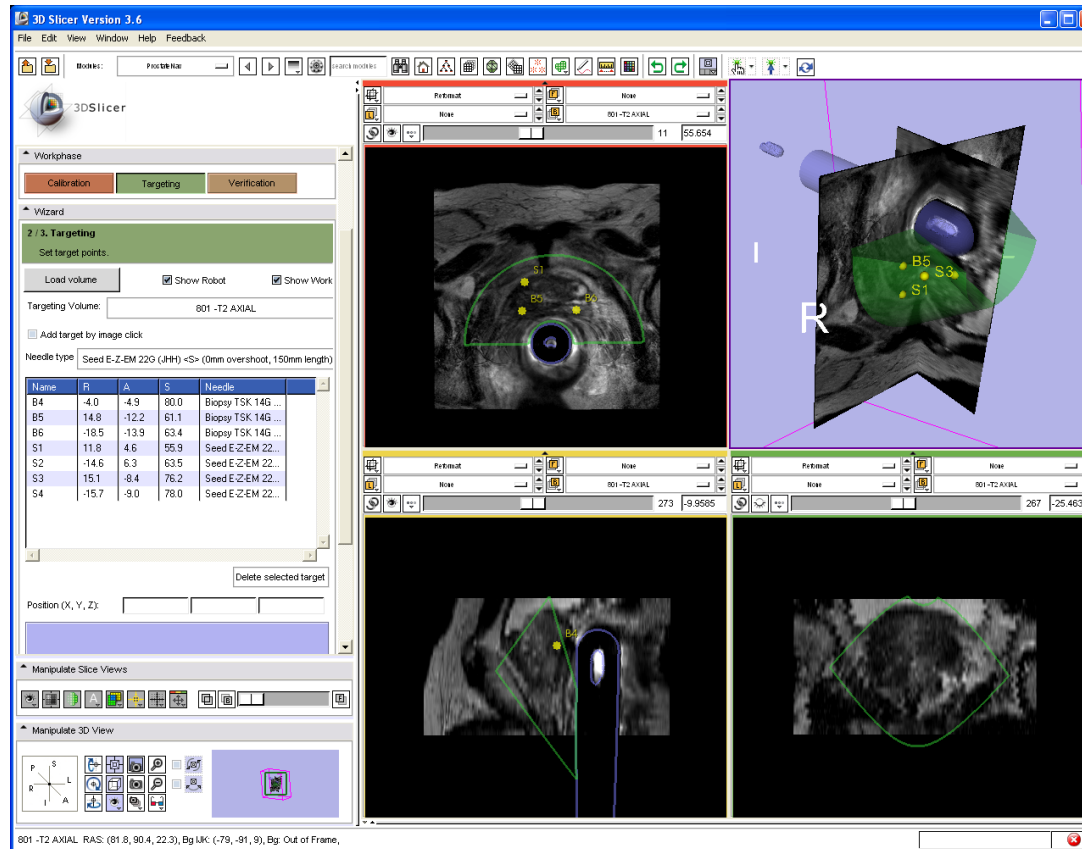
Image-guided biopsy workflow steps



Calibration



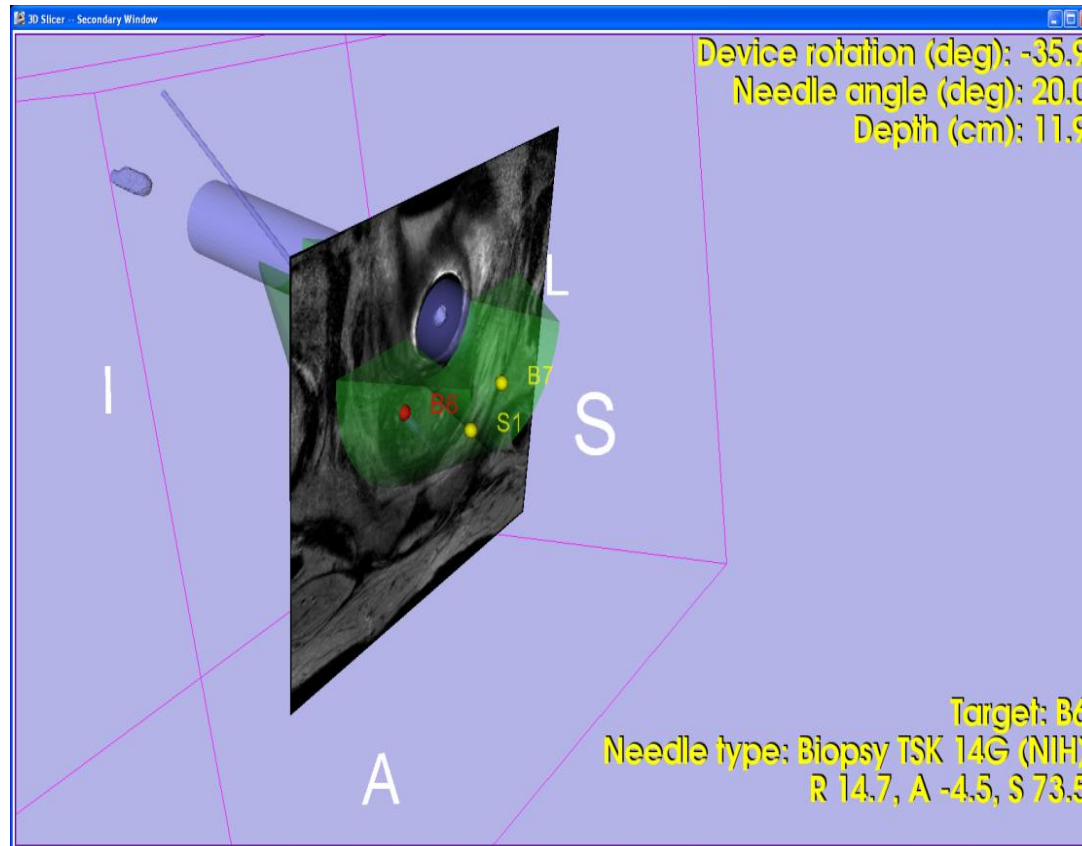
Planning



- Register/show available images
- Mark point targets

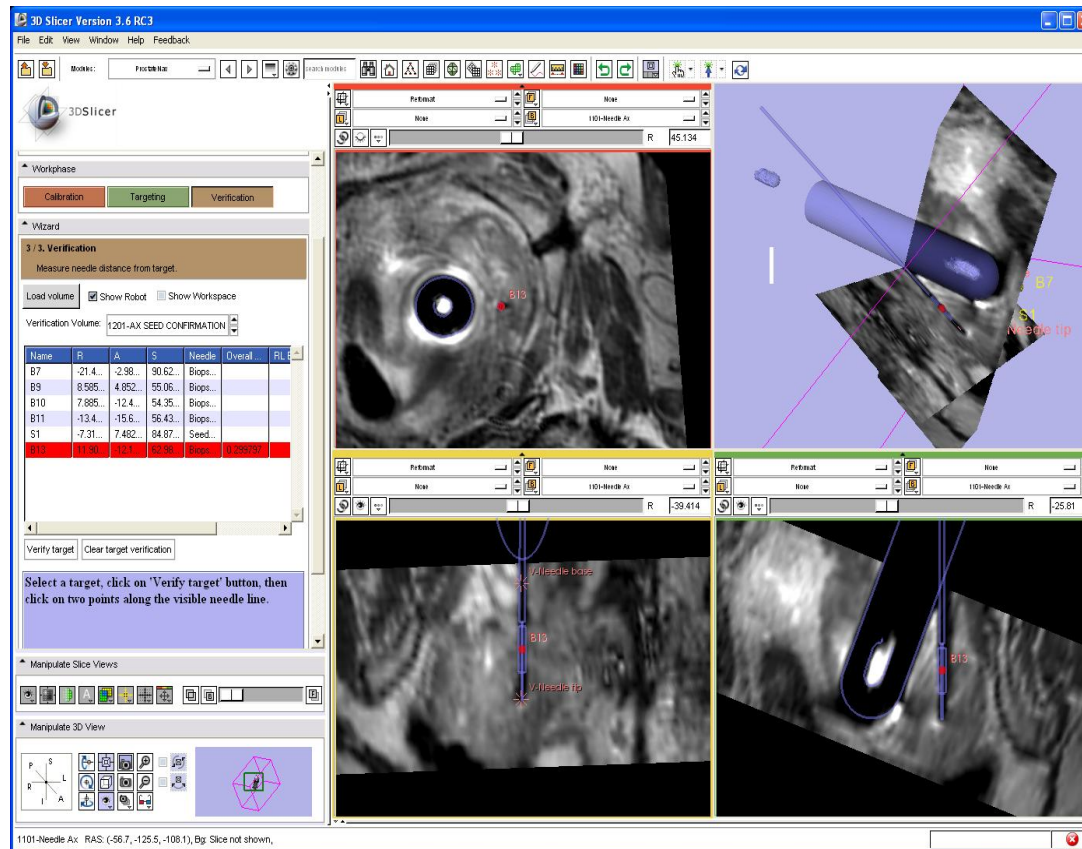


Targeting



- Simplified display on procedure-room monitor
- Robot, scanner control

Verification



- Verify patient, robot, and needle position
- Using automatic image registration



3D Slicer clinical use – summary

- Successful example: same software, multiple devices, multiple sites
- Use existing features in 3D Slicer
- Customization
 - Software development: algorithms and graphical user interface
 - Quality assurance process: testing, change control, releases, issue tracking



3D Slicer for radiation therapy research



Active projects

- Adaptive radiotherapy for head and neck cancer
([http://www.na-mic.org/pages/DBP:Head and Neck Cancer](http://www.na-mic.org/pages/DBP:Head_and_Neck_Cancer))
 - Funded by NA-MIC, 2010-2013
 - PI: Greg Sharp (MGH, Boston, MA)
 - 4 researchers, software engineers
- SparKit: toolkit and platform for radiotherapy
(<https://www.assembla.com/spaces/sparkit/>)
 - Funded by Cancer Care Ontario, 2011-2016
 - PI: G. Fichtinger (Queen's University, Kingston, ON)
Co-investigator: Terry Peters (Robarts Institute, London, ON)
Project leader: Andras Lasso (Queen's University, Kingston, ON)
 - 6-8 software engineers and infrastructure
- NA-MIC collaborations in preparation
([http://www.na-mic.org/Wiki/index.php/Events:Computational Methods for Radiation Oncology](http://www.na-mic.org/Wiki/index.php/Events:Computational_Methods_for_Radiation_Oncology))



SparKit: Software Platform and Adaptive Radiotherapy Kit

- ↪ Software Platform (SP): shared, reusable, and customizable basic software components for radiotherapy
- ↪ Adaptive Radiotherapy Kit (ARKit): Specific toolkit for adaptive radiation therapy and associated image-guided interventions

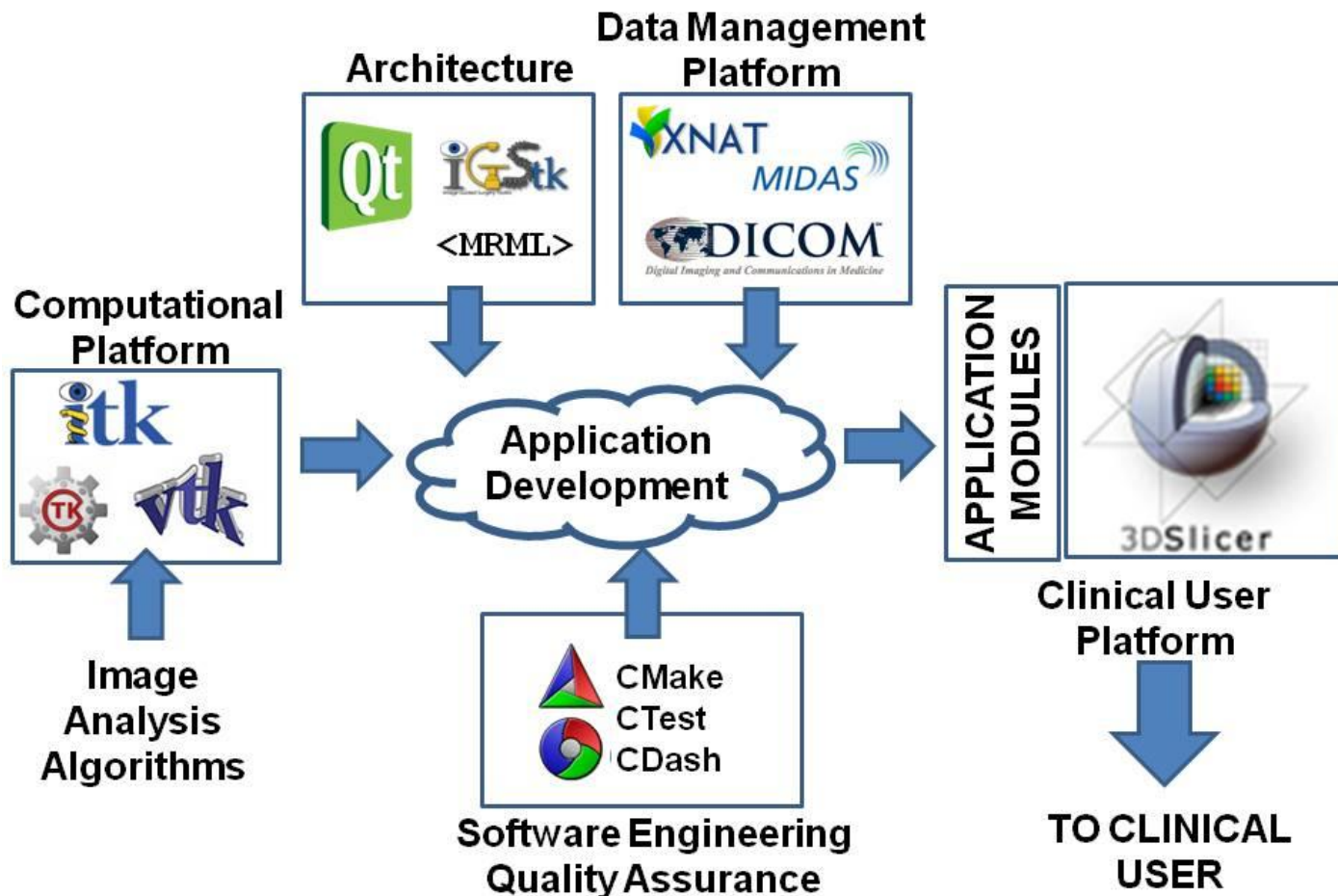
Goals:

- Validate clinical hypotheses in clinical trials
- Ready-to-use image analysis and visualization capabilities
=> avoid re-development
- Quickly deployable systems
=> minimize system engineering effort

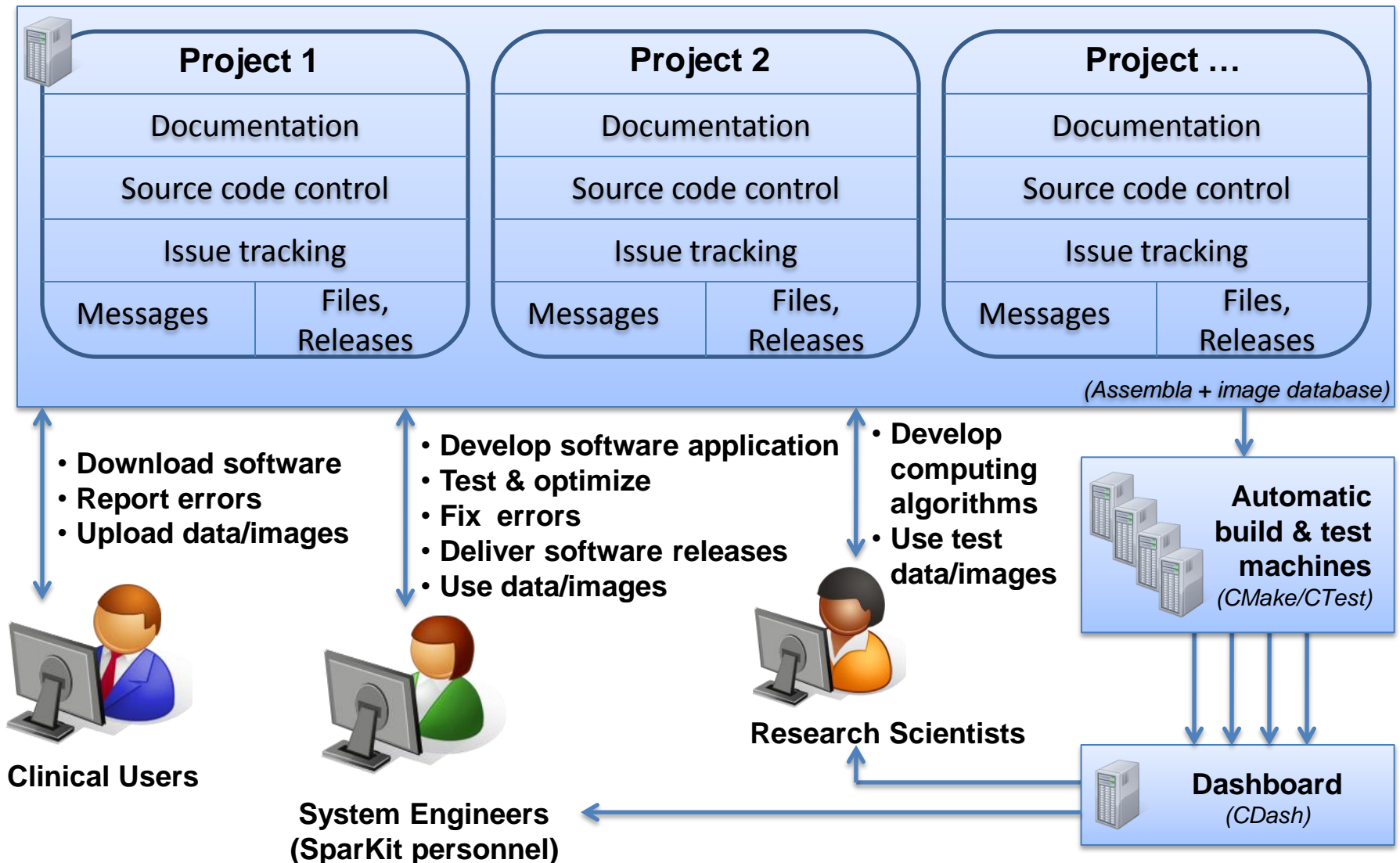


SparKit tools

Based on 3D Slicer and the NA-MIC kit



SparKit infrastructure



Project scope (tentative)

- DICOM-RT support in 3D Slicer: import/export structure sets and dose maps
- Visualization: dose volume histogram, isodose lines
- Better support for temporally changing data (2D+t, 3D+t)
- 3D Slicer performance optimization
- Image and protocol data sharing infrastructure
- ... still collecting inputs from the community



Current SparKit activities

- **Set up team & infrastructure**
 - www.assembla.com/spaces/sparkit
 - Software engineers hiring
- **Identify needs**
 - Survey, meetings
- **Set up collaborations**



3D Slicer for your own problem

Programming 3D Slicer



Main concepts

- All information is stored in MRML (Medical Reality Modeling Language) nodes
 - Node types: images, models, transforms, fiducial lists, etc.
 - Observer pattern: MRML nodes notify their observers of any state changes
- Extension/customization via plugin *modules*
 - Define new nodes, observe existing MRML nodes
 - ITK, VTK, Teem, Curl, OpenIGTLink, QT already available



Programming 3D Slicer

- Command-line module: `.exe` file (with specific command-line parameters)



– simple, executable without Slicer



– no access to Slicer internals, Slicer compilation needed

- Scripted module: Python or TCL scripts



– simple, no compilation needed



– limited access to Slicer internals

- Loadable (interactive) module: `.dll` (with specific Slicer API interface)



– full access to Slicer internals



– Slicer compilation needed, requires Slicer core knowledge



Getting started

- Download: <http://www.slicer.org/pages/Special:SlicerDownloads>
- Latest stable version (recommended)
 - Type of download: *Stable Releases*
 - File to download: latest date
- Documentation, examples, step-by-step tutorials, etc:
<http://www.slicer.org/>
- 3D Slicer training courses, developer meetings:
<http://www.na-mic.org/Wiki/index.php/Events>
- Slicer4 (faster, nicer, ...) is expected to be released for RSNA 2011



Thank you.

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