3D Slicer
for clinical use,
for radiotherapy research,
and for 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
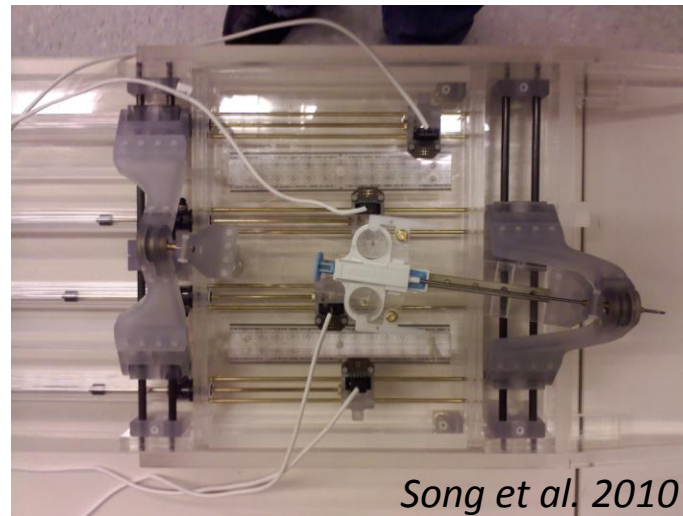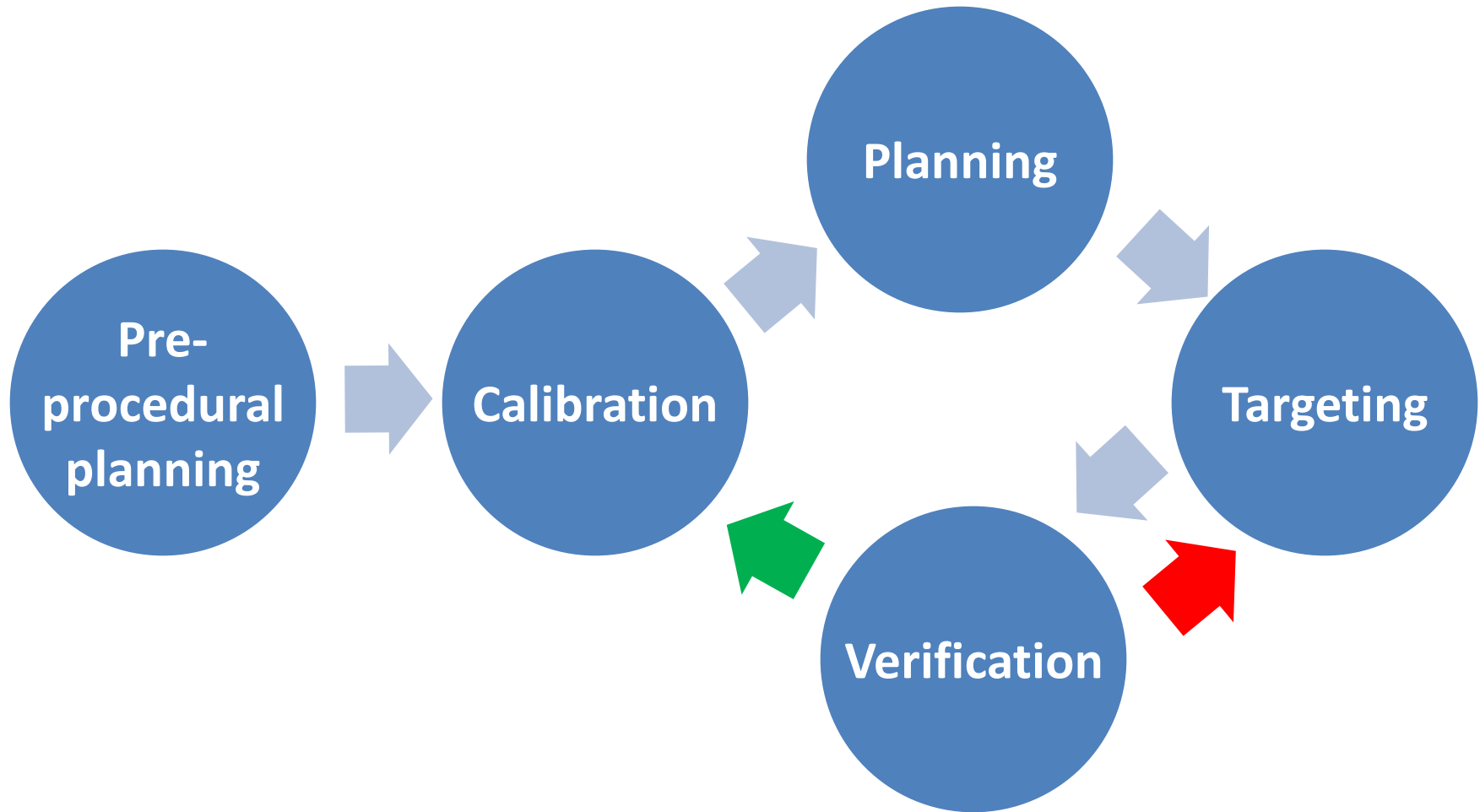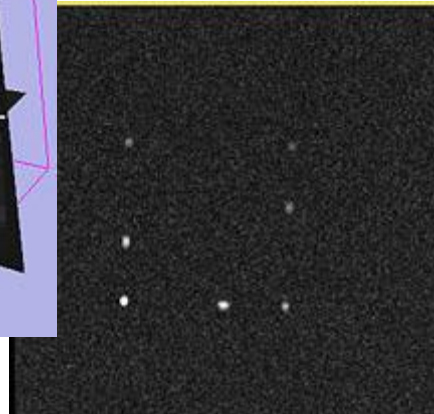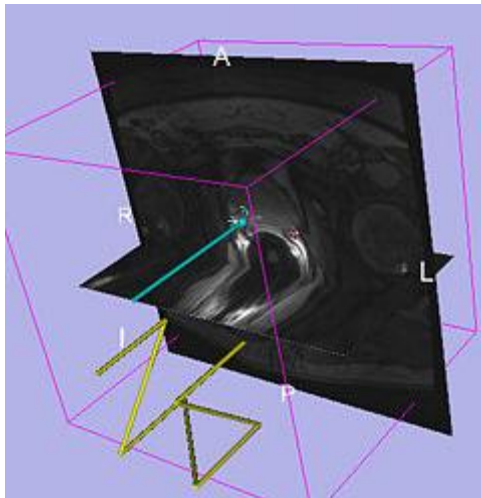- PMH (Toronto, ON): image sharing only

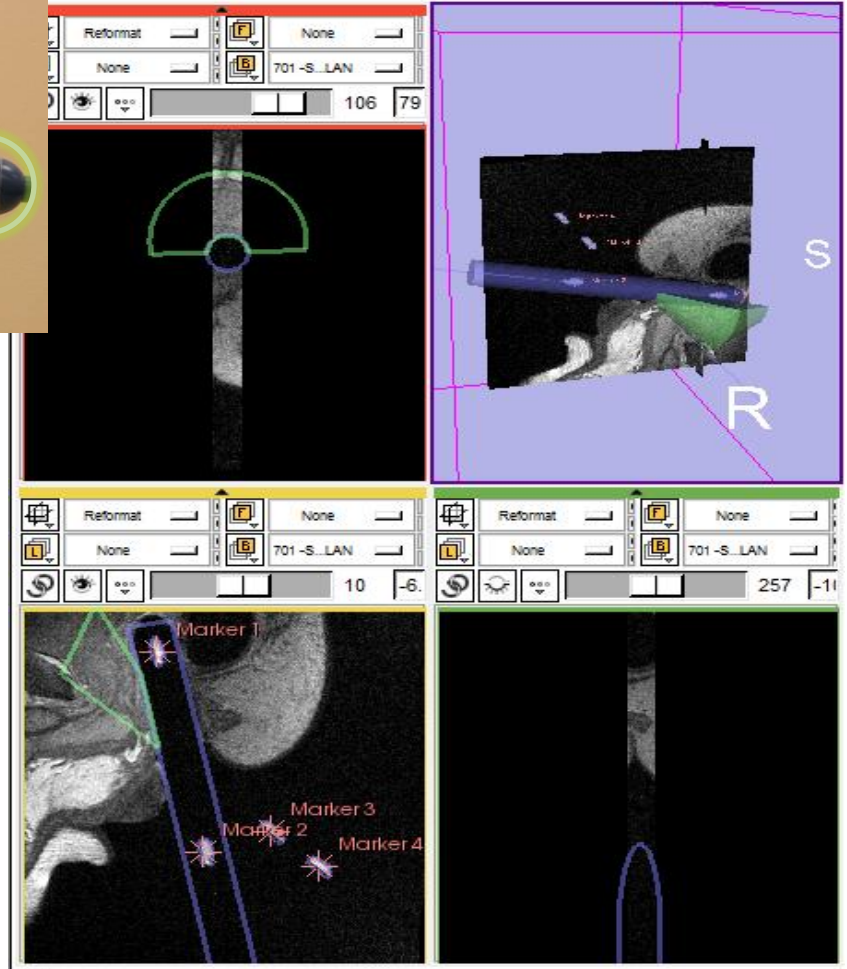*Krieger et al. 2005*

Song et al. 2010
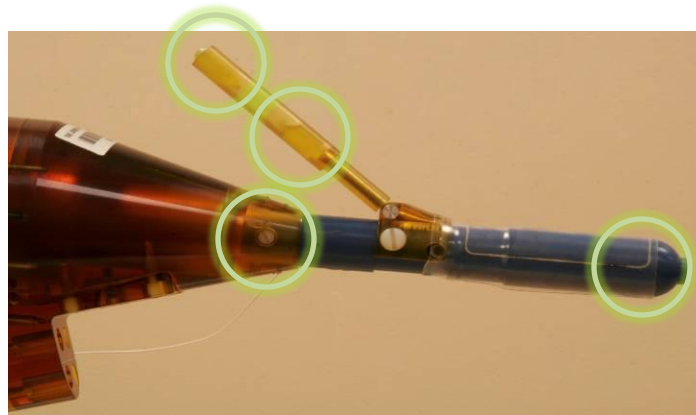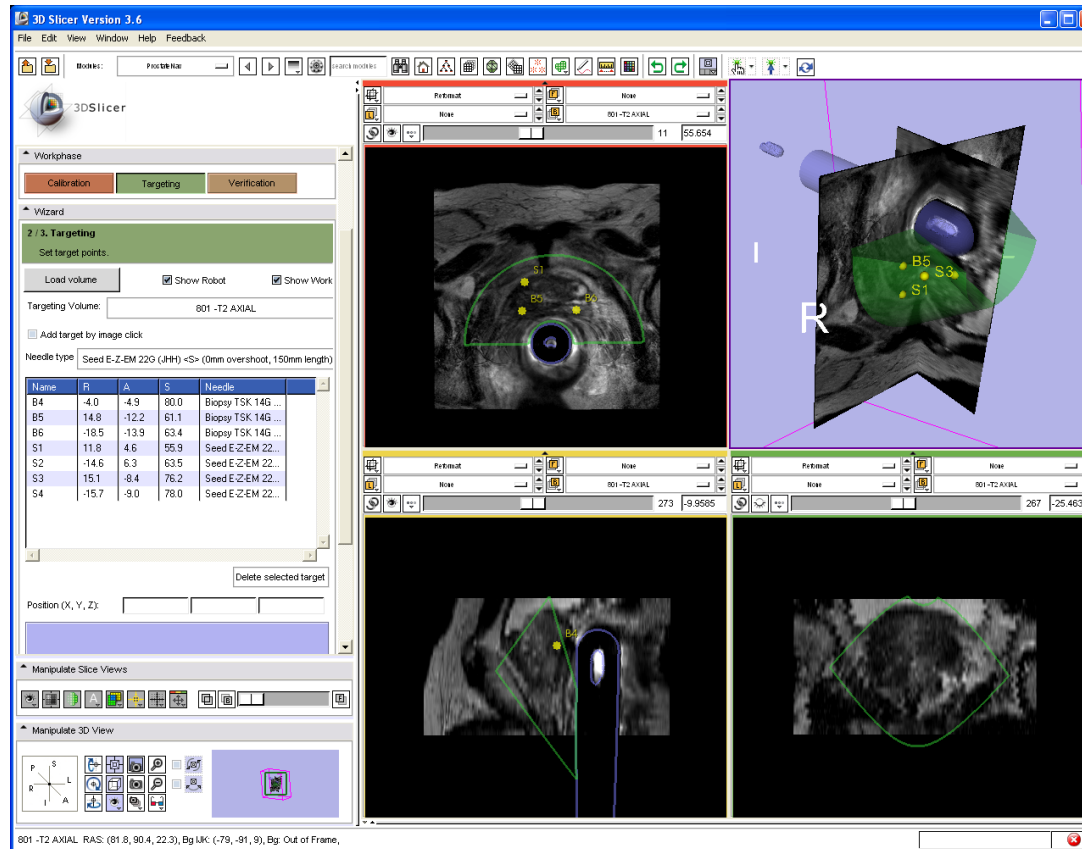

Tokuda et al. 2011

Image-guided biopsy workflow steps

Calibration

Planning

- Register/show available images
- Mark point targets

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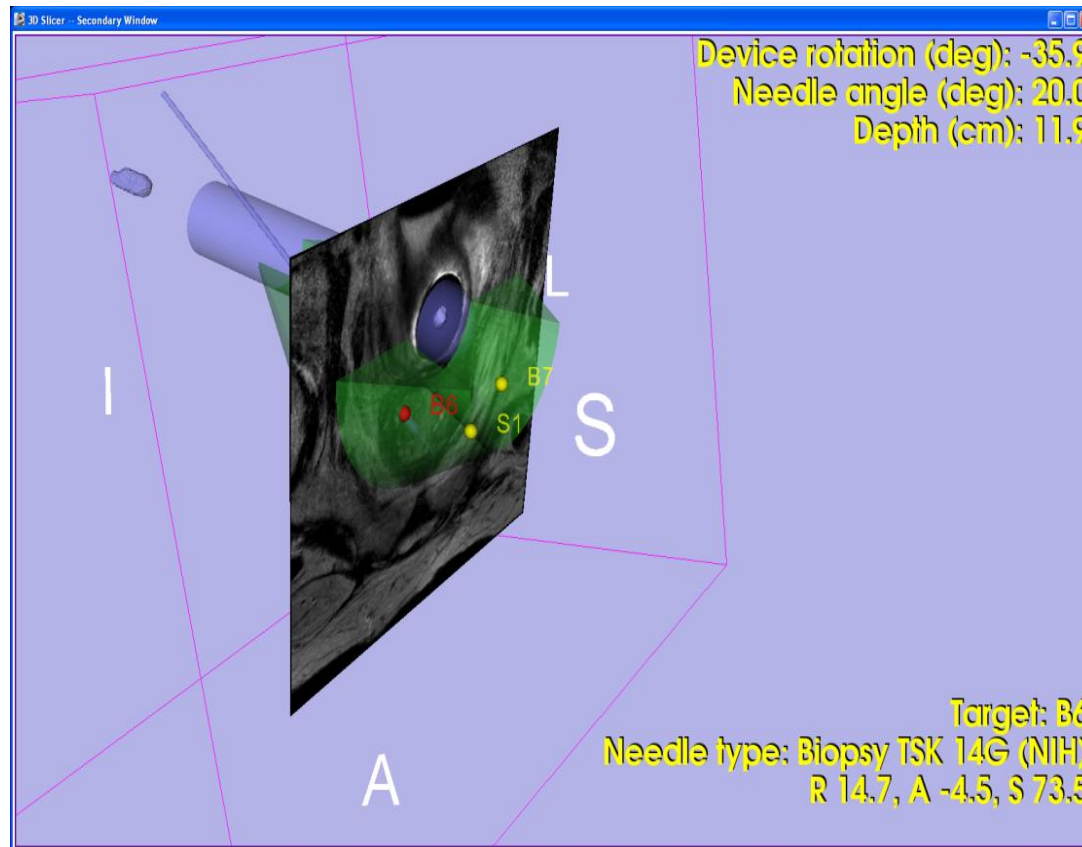
- Simplified display on procedure-room monitor
- Robot, scanner control

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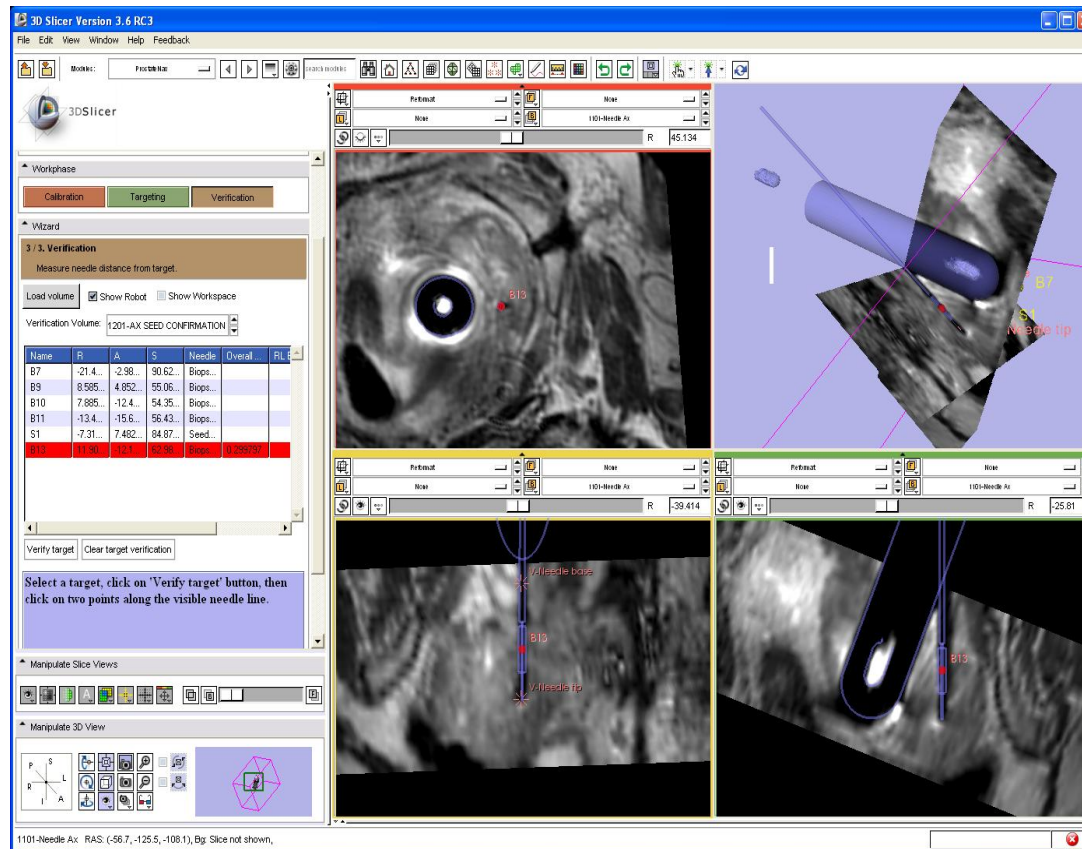
- Verify patient, robot, and needle position
- Using automatic image registration

3D Slicer clinical use – summary

- Successful examples: same software, multiple devices, multiple sites

- Use existing features in 3D Slicer

- Customization
  - Software development: algorithms and graphical user interface
  - Quality assurance process: documentation, 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)
  - 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)

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
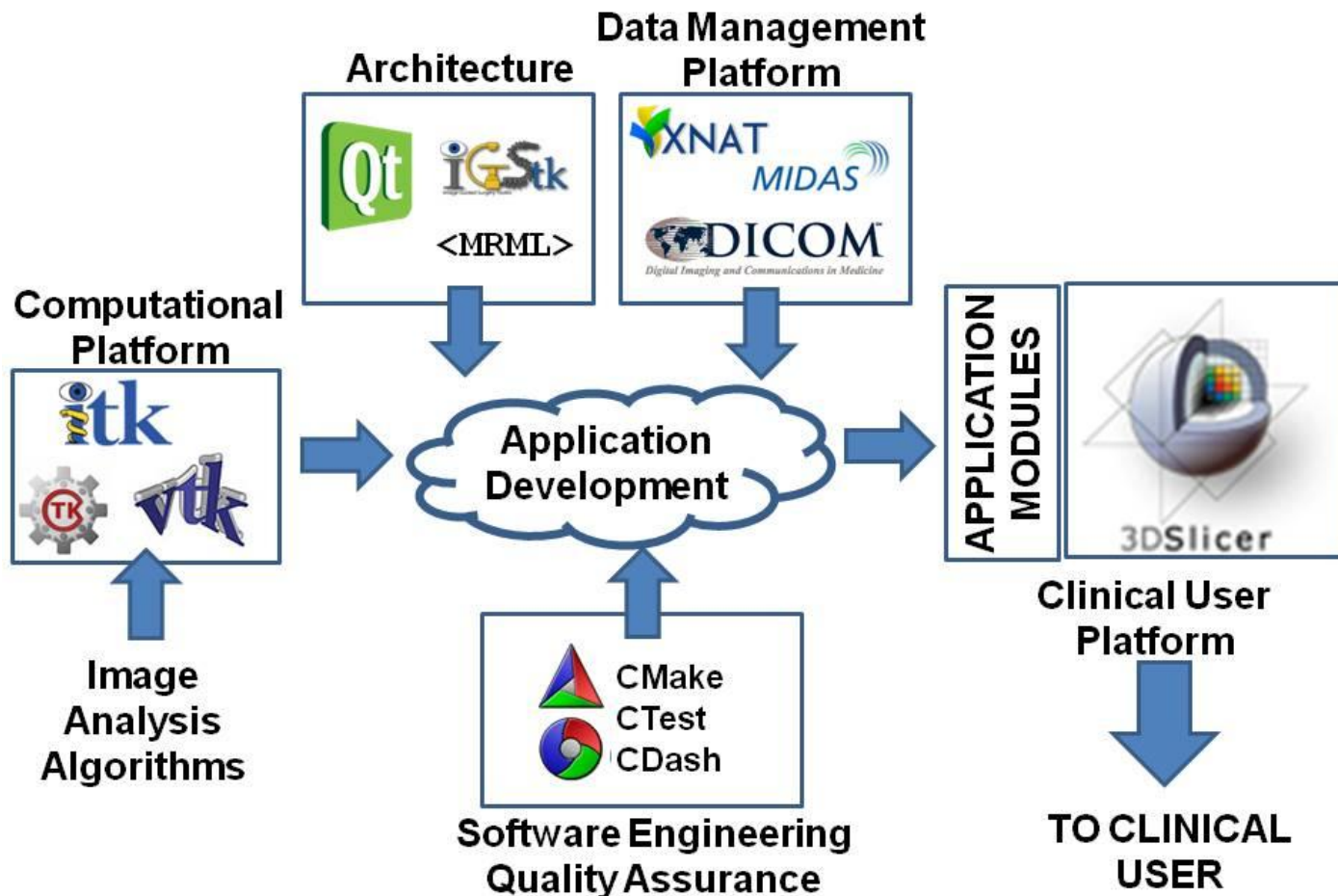
Goals:

- 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

Laboratory for Percutaneous Surgery (The Perk Lab) – Copyright © Queen's University, 2011
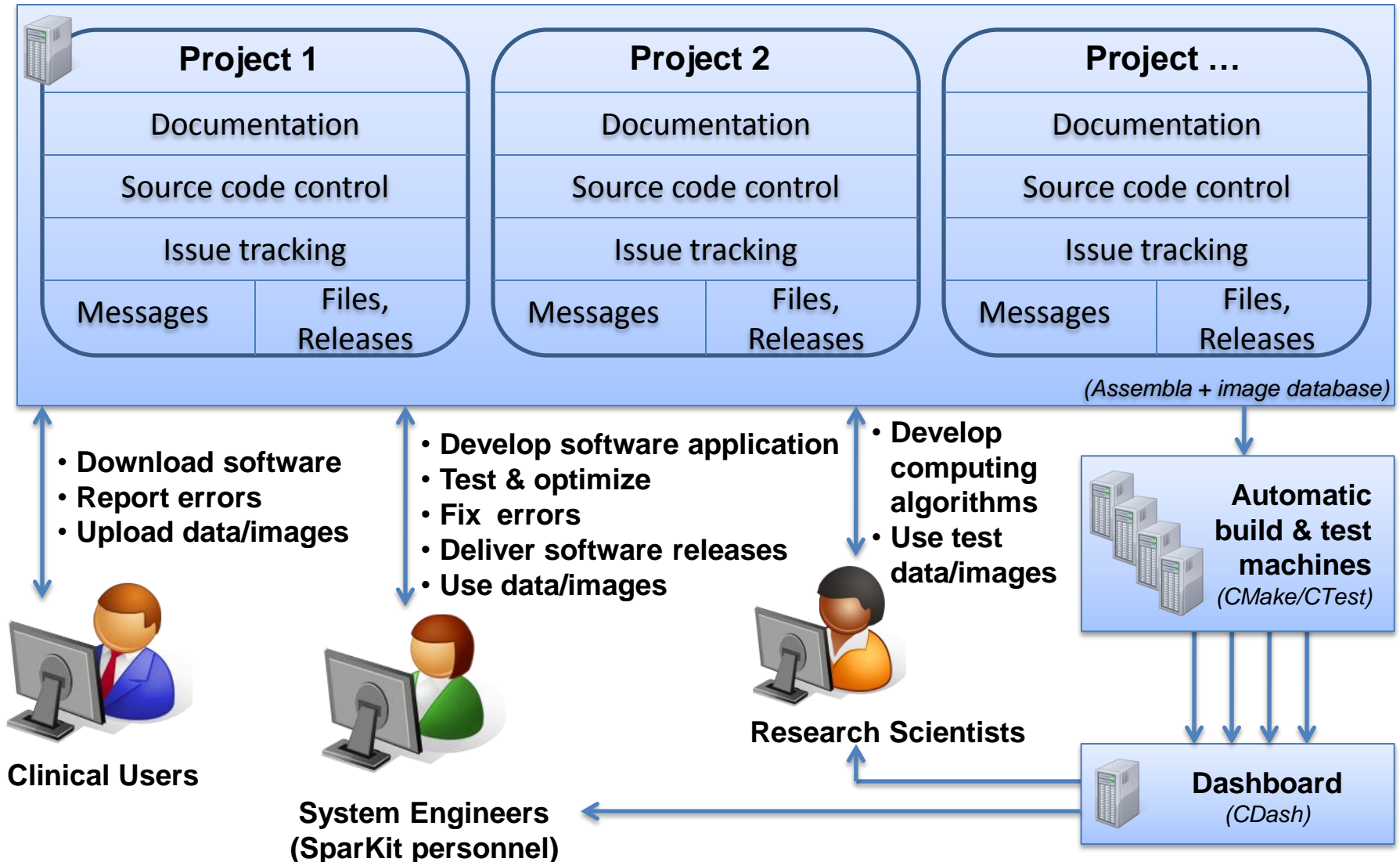
Project scope (tentative)

- 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

- Scripted module: Python or TCL scripts
  - simple, no compilation needed
  - limited access to Slicer internals

- Command-line module: .exe file (with specific command-line parameters)
  - simple, executable without Slicer
  - no access to Slicer internals, Slicer compilation needed

- 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
    (*Slicer3-3.6.2-2010-11-03*)

- 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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