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SlicerRT

Image-guided radiation therapy research toolkit for 3D Slicer

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Queen's University

Laboratory for Percutaneous Surgery

SparKit

SparKit project overview

- Goal: provide open-source platform for translational clinical research, mainly cancer
- Themes:
  - **SlicerRT: radiotherapy toolkit for 3D Slicer**
  - SlicerIGT: Image-guided therapy with 3D Slicer
- Funding by Cancer Care Ontario till 2016
- PI & co-PIs: Gabor Fichtinger (Queen's), David Jaffray (Toronto UHN), Terry Peters (Robarts)

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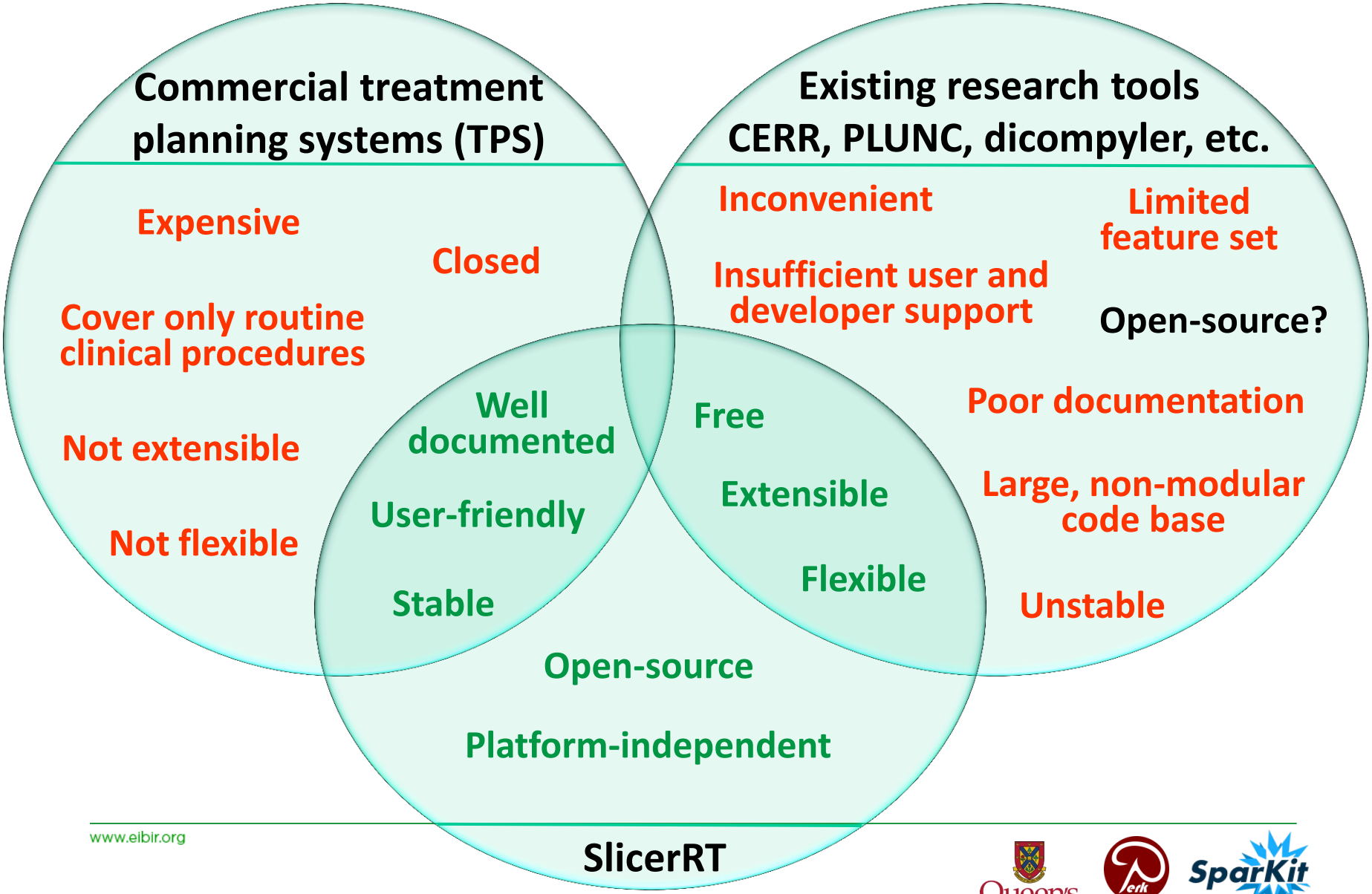
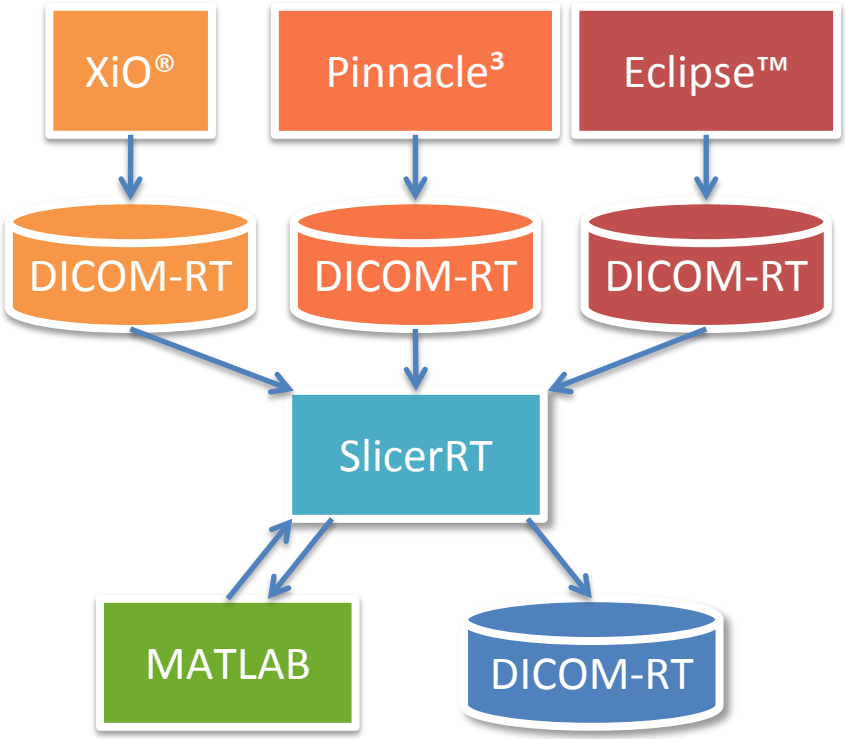
Motivation behind SlicerRT



Development principles

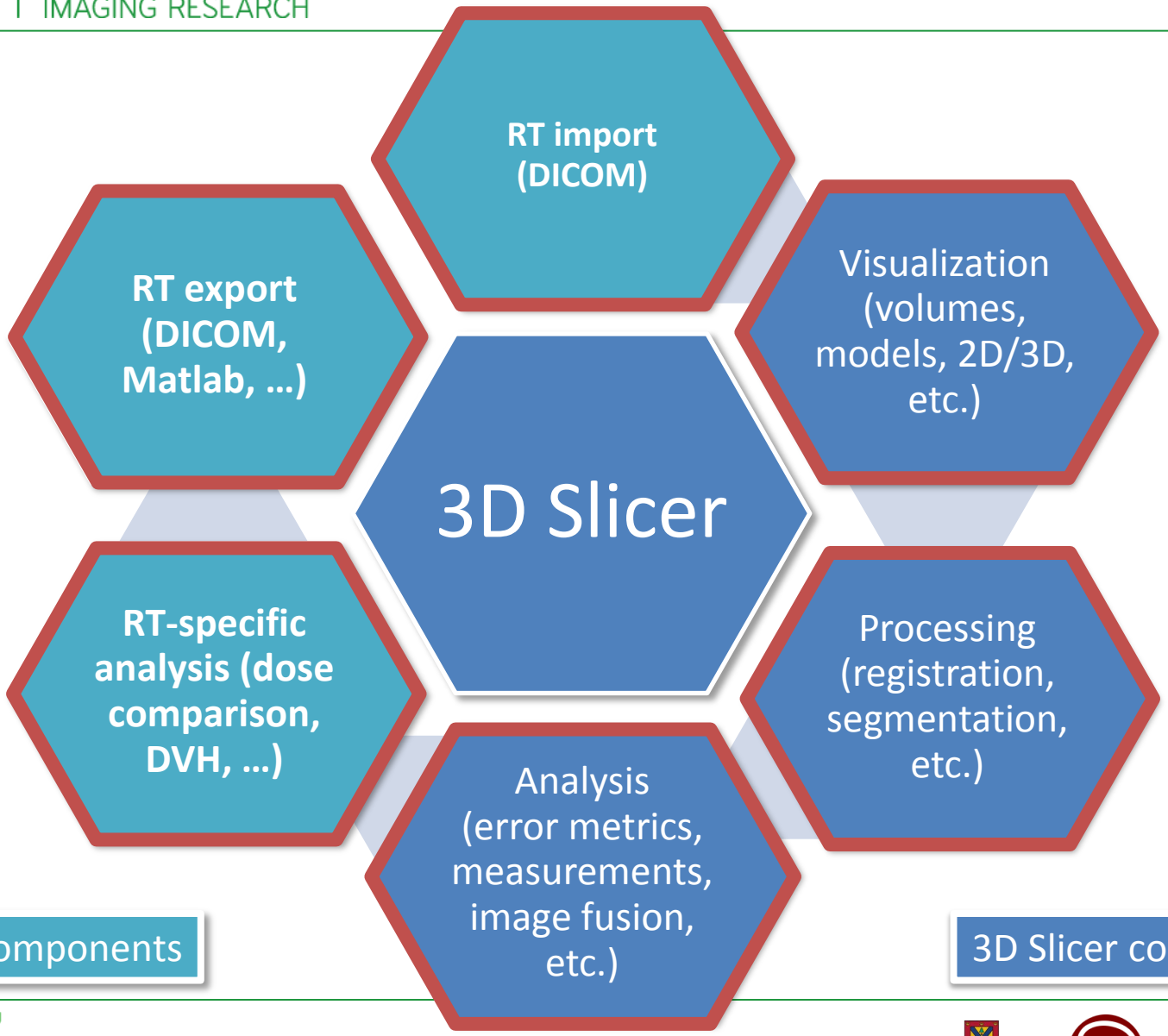
- Leverage existing tools and parallel efforts: 3D Slicer[1], Plastimatch[2]
- "Hub" for RT data analysis and comparison
- Cover most common RT research workflows
- Free, open-source license (BSD)
- Open to integrate algorithms
- Extensive documentation



[1] S. Pieper, M. Halle, and R. Kikinis, 3D SLICER. *Proceedings of the 1st IEEE International Symposium on Biomedical Imaging: From Nano to Macro* (Brigham and Women's Hospital, Boston, MA, 2004), pp. 632–635.

[2] G. C. Sharp, R. Li, J. Wolfgang, G. Chen, M. Peroni, M. F. Spadea, S. Mori, J. Zhang, J. Shackleford, and N. Kandasamy, "Plastimatch: An open source software suite for radiotherapy image processing," in *Proceedings of the XVIth International Conference on the Use of Computers in Radiotherapy (ICCR)* (Amsterdam, the Netherlands, 2010).

General workflow overview



SlicerRT components

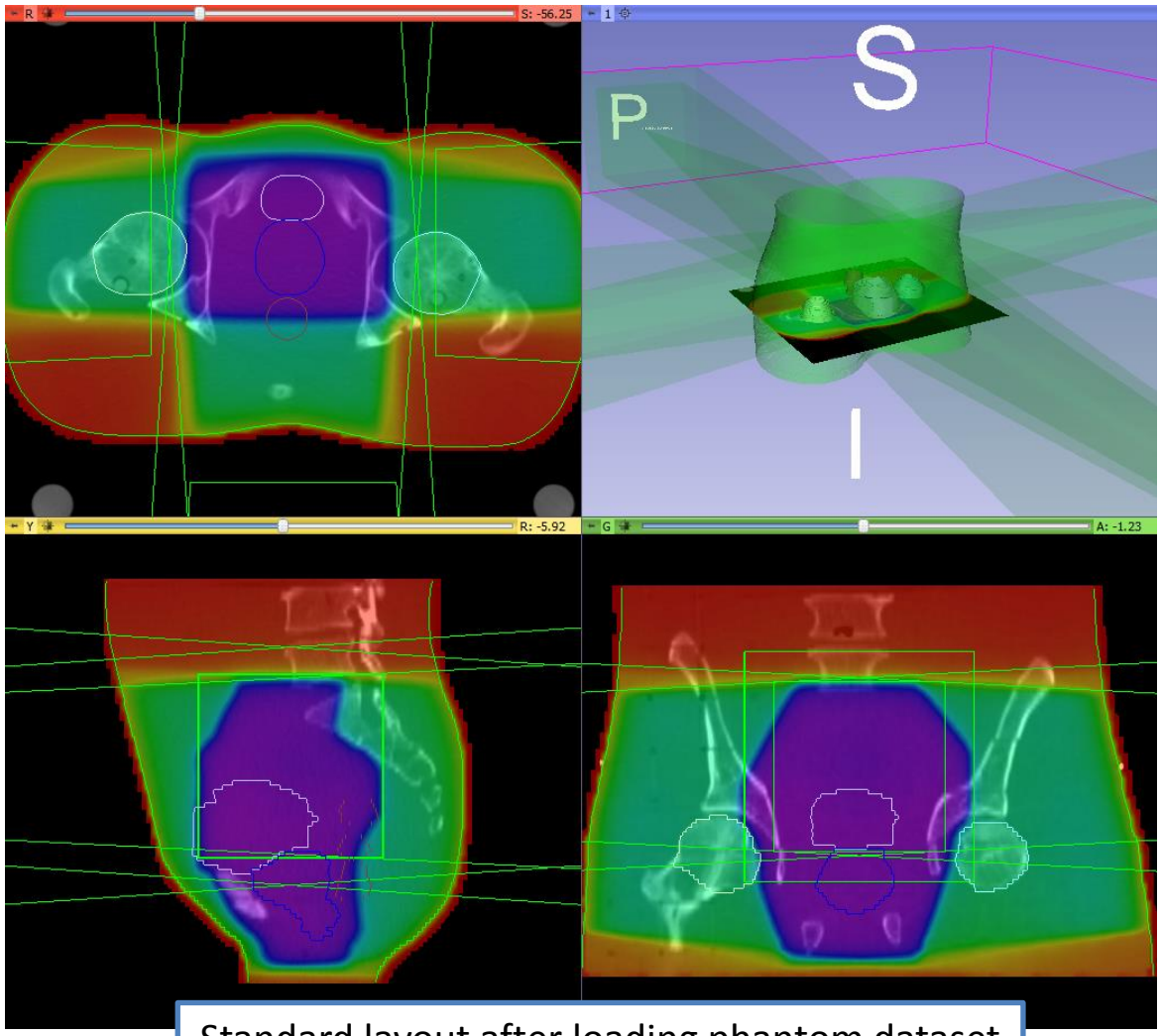
3D Slicer components

Queen's University

SparKit

DICOM-RT import

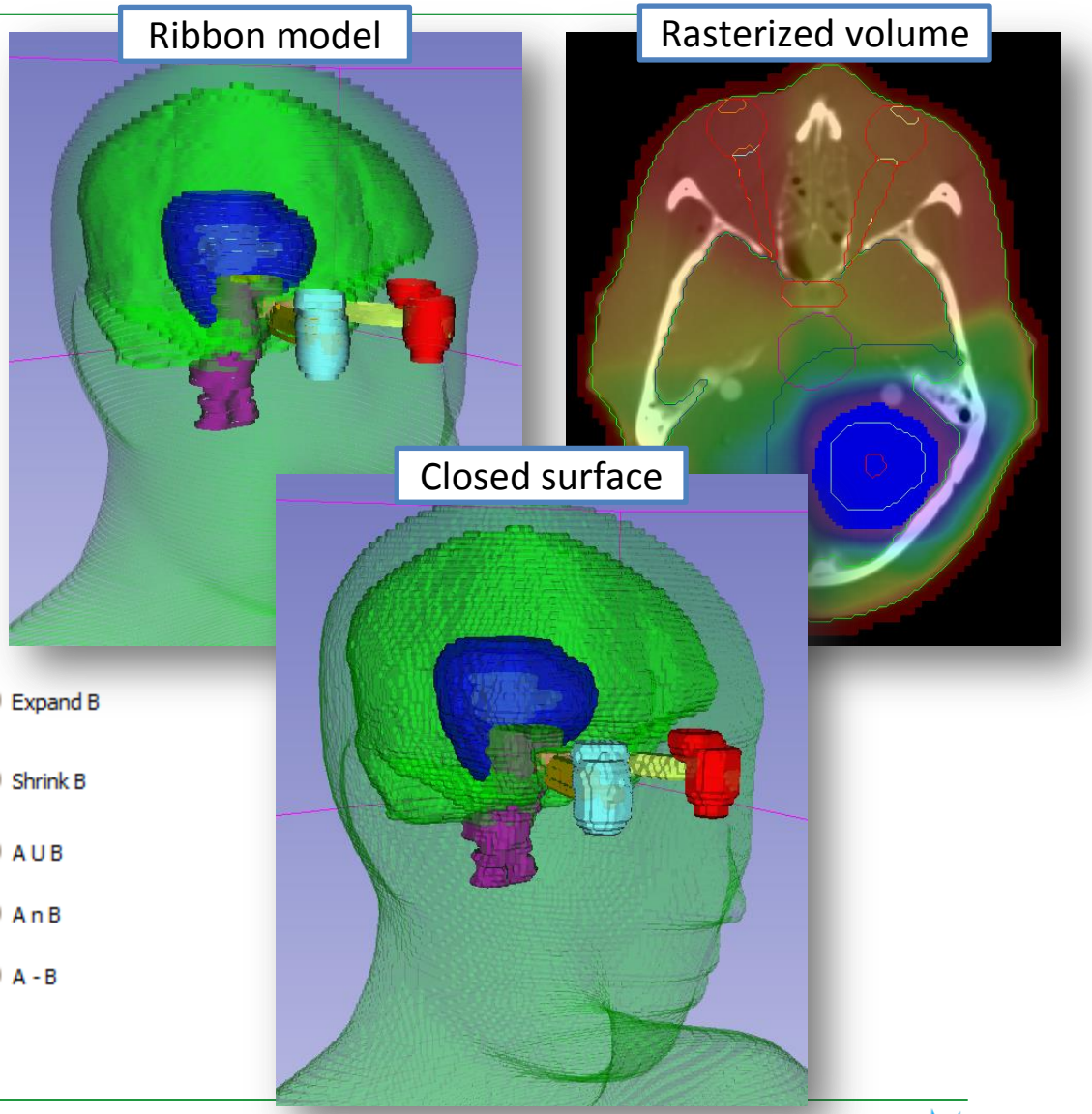
- Integrated into core DICOM import plugin mechanism
- Data is organized in a smart hierarchy
- Supported data types:
  - RT structure sets
    → Contours
    → Fiducial point
  - RT dose map
  - RT image
  - RT plan: isocenter, beams
  - Planning CT, MR, etc.



Standard layout after loading phantom dataset

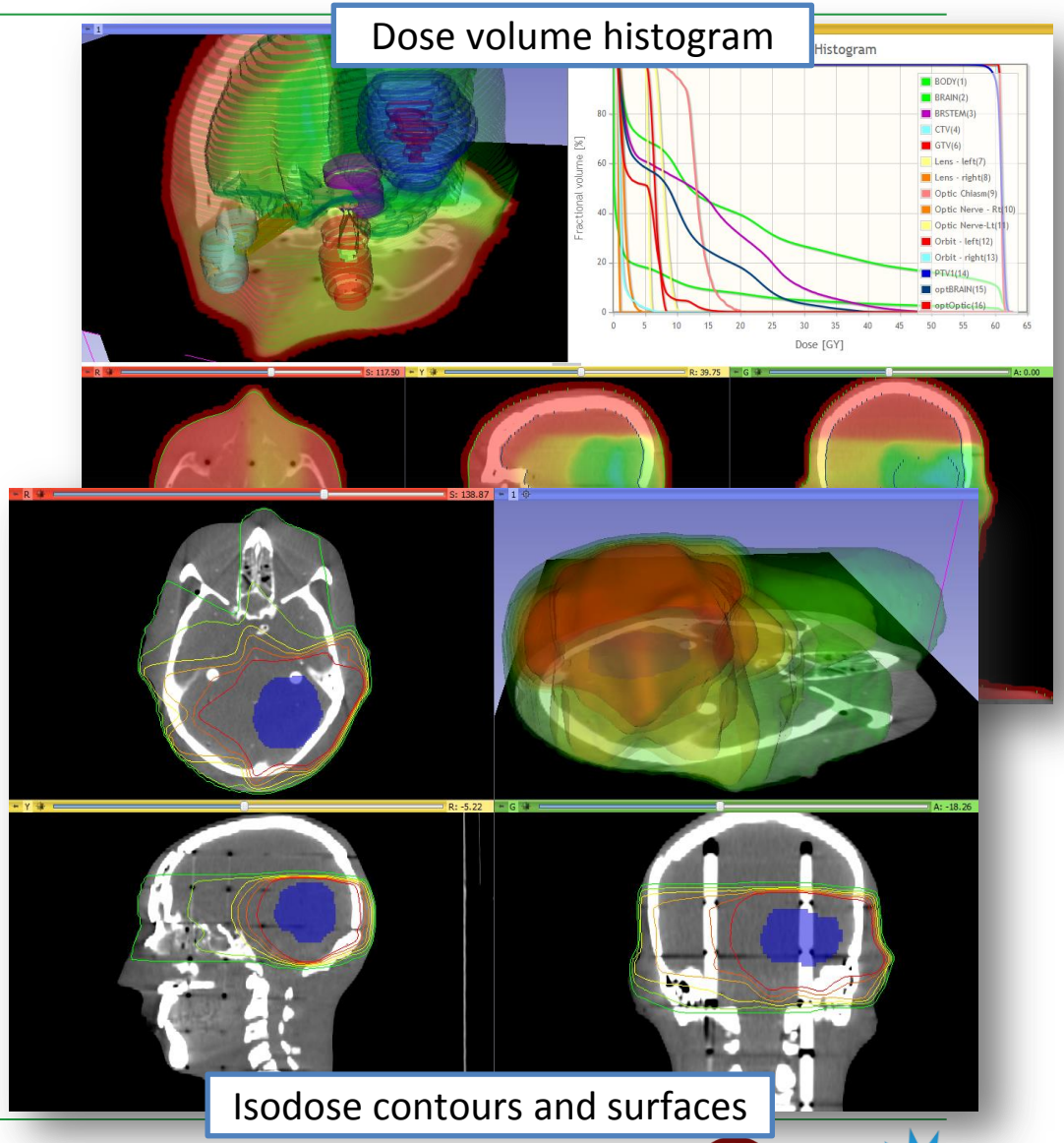
Contour analysis

- Multiple representations (automatic conversion)
  - Ribbon model
  - Rasterized volume
  - Closed surface model
- Contour comparison
  - Dice coefficient
  - Hausdorff distance
- Contour morphology
  - Expand, shrink
  - Combine using logical operators



Dose analysis

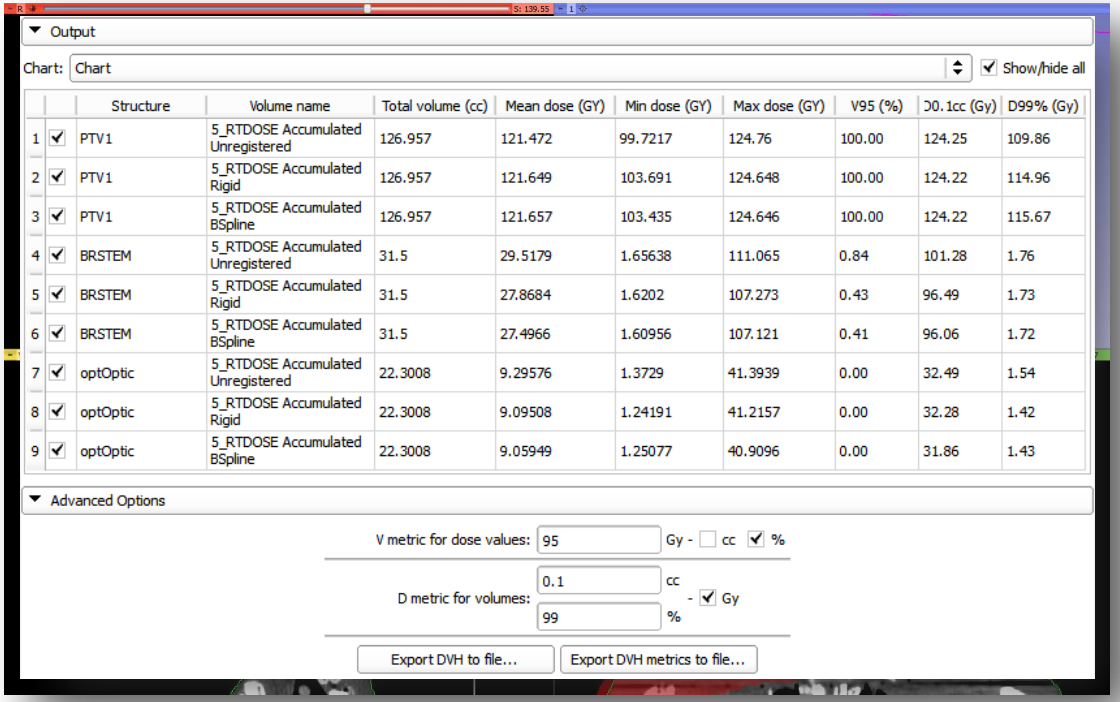
- Dose volume histogram (plot visualization + metrics)
- Dose accumulation
- Dose comparison (gamma)
- Isodose contours / surfaces
- Visualize deformation fields
- Proton dose computation
- Registration
  - BSpline registration
  - Landwarp registration



Example use case

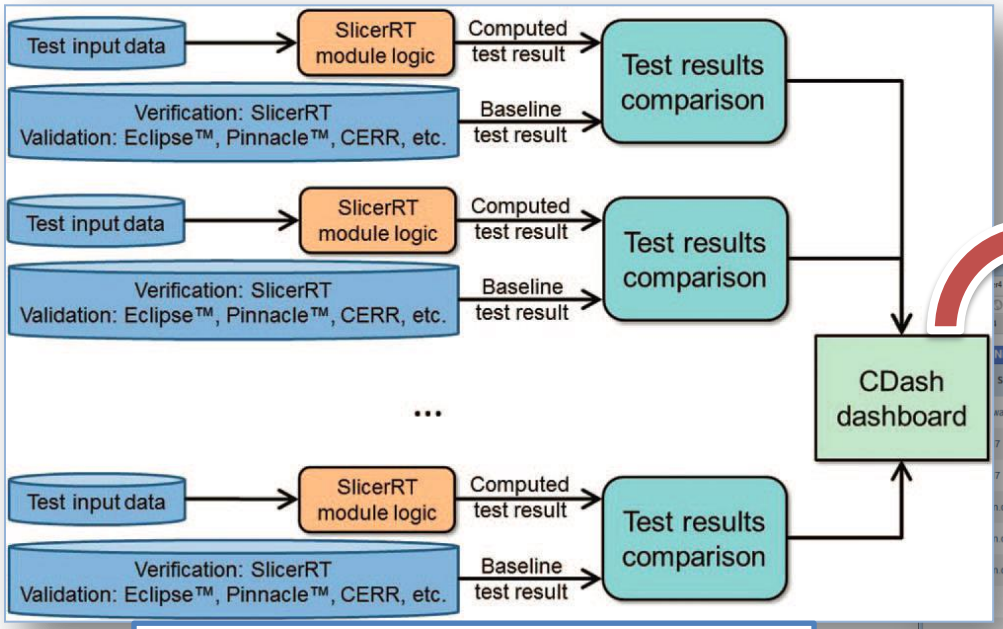
Use case: Evaluate the effectiveness of RT plan adaptation

- Import, load and visualize data
- Register day 1 CT with day 2 CT
  - Rigid
  - Bspline
- Resample day 2 dose using results
- Accumulate doses
- Compute and display DVH for all methods
- Compare DVH curves and metrics for target volume and organs at risk



Software quality

- Extensive automatic testing done on multiple platforms every night
- Validated against other software packages (Pinnacle, CERR, …)



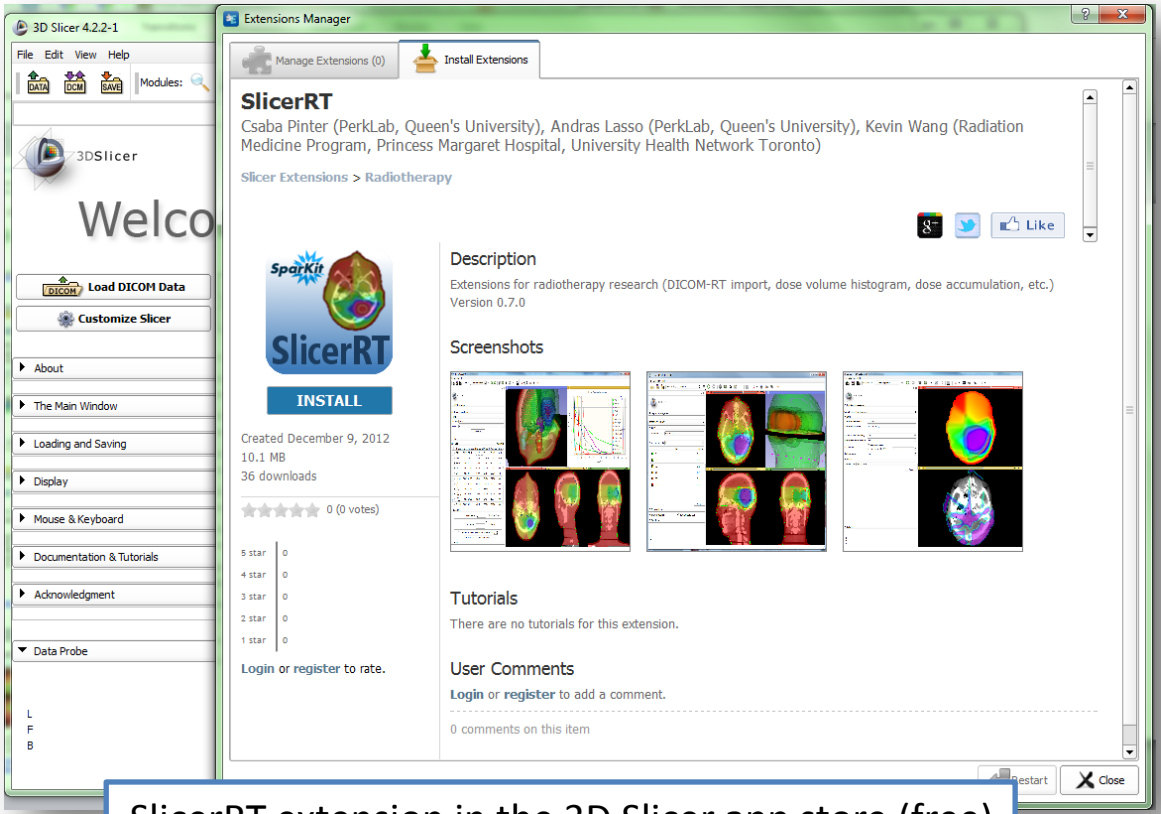
Automatic test infrastructure for automatic verification and validation

Test results reported to the web-based dashboard

http://slicer.cdash.org/index.php?project=Slicer4

Extension for 3D Slicer

- Collection of RT-specific modules, includes Plastimatch
- Distributed as a 3D Slicer extension: can be downloaded, installed, upgraded using the extension manager in Slicer

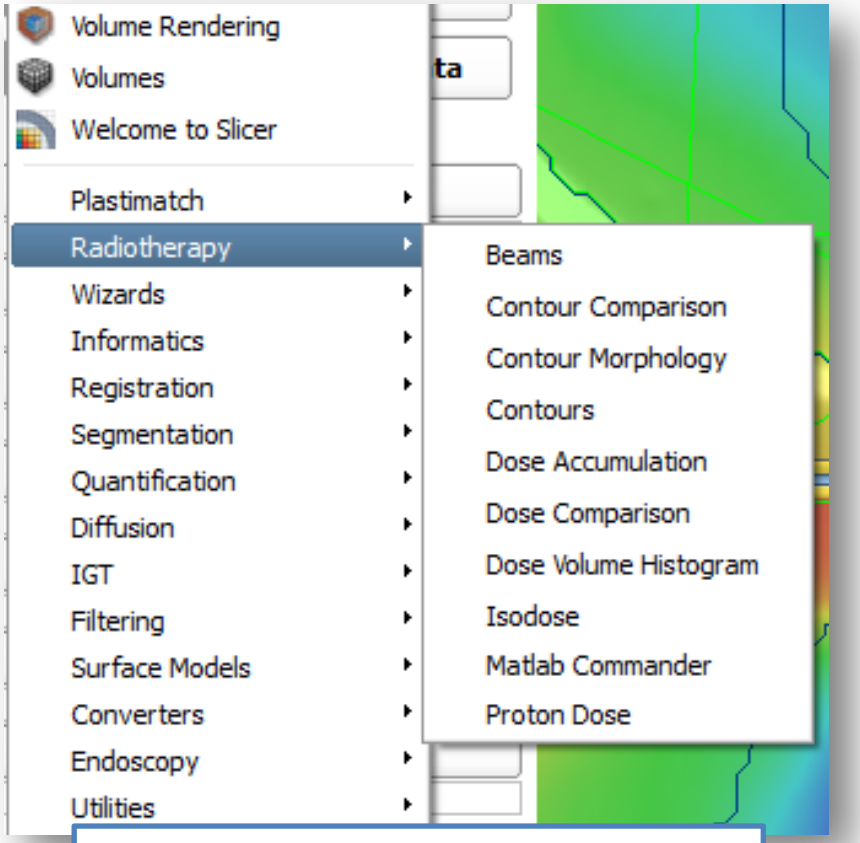


SlicerRT extension in the 3D Slicer app store (free)

Next steps

Enhancements planned for the next 6 months:

- DICOM-RT export
- Matlab bridge interface: execute Matlab functions from 3D Slicer
- Digitally reconstructed radiograph
- Support CERR PlanC format
- Scripting examples
- More testing and validation



Current radiotherapy modules (including work-in-progress modules)

Detailed plan: https://www.assembla.com/spaces/slicerrt/tickets

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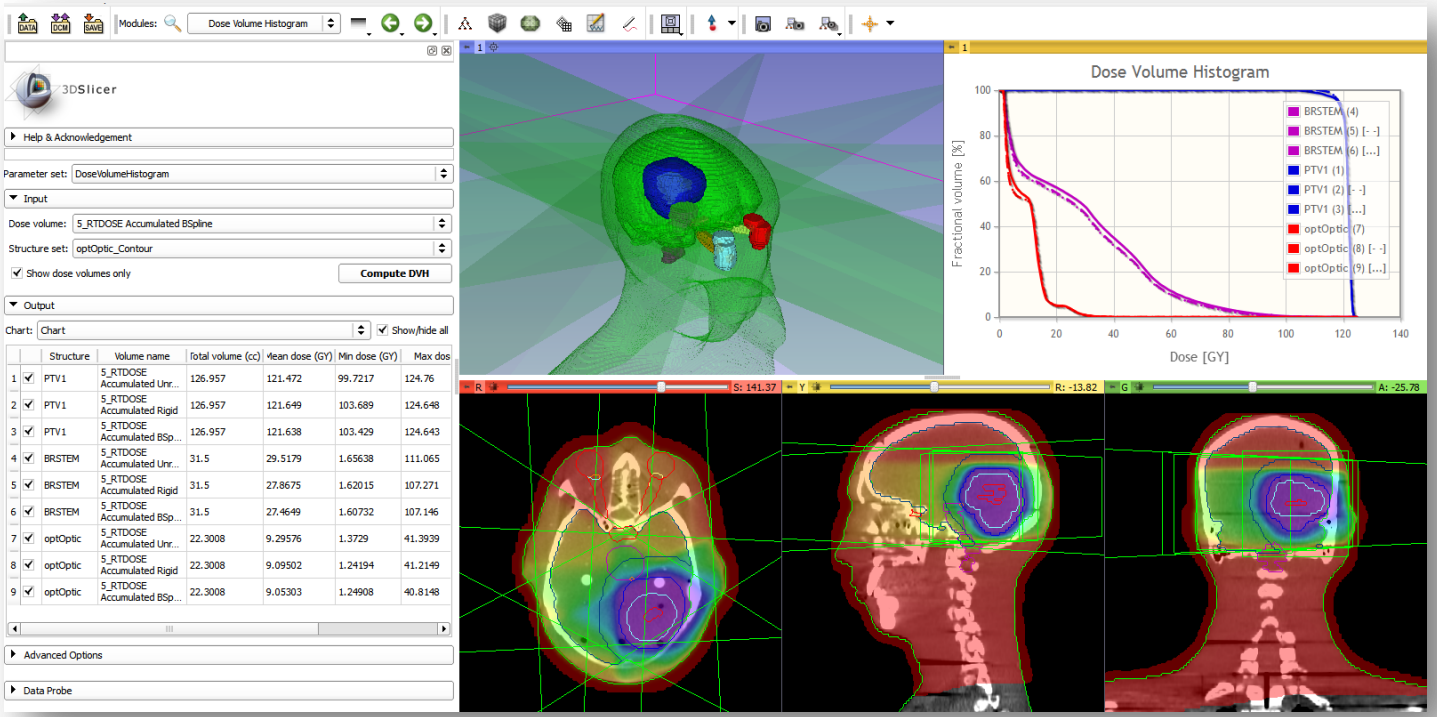
Thank you!



- Overview paper: Csaba Pinter, Andras Lasso, An Wang, David Jaffray, and Gabor Fichtinger, “SlicerRT: Radiation therapy research toolkit for 3D Slicer”, Med. Phys. 39 (10), October 2012
- Project homepage: http://www.SlicerRT.org/
- Contact: Csaba Pinter (pinter@cs.queensu.ca)