SlicerRT

Image-guided radiation therapy research toolkit for 3D Slicer

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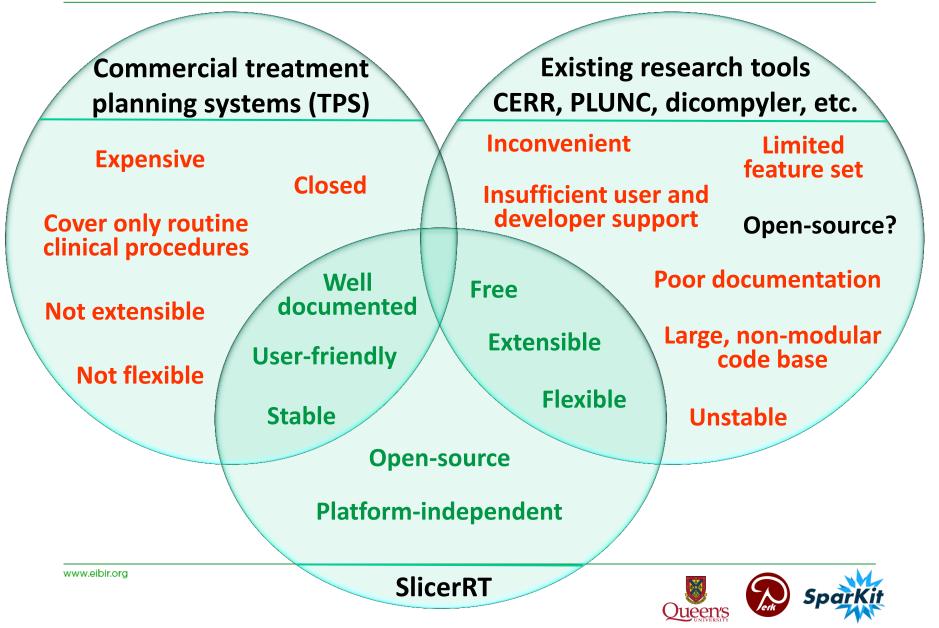


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- Goal: provide open-source platform for translational clinical research, mainly cancer
- Themes:
 - SlicerRT: radiotherapy toolkit for 3D Slicer
 - SlicerIGT: Image-guided therapy with 3D Slicer
- Funding by Cancer Care Ontario till 2016
- PI & co-Pls: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



Motivation behind SlicerRT



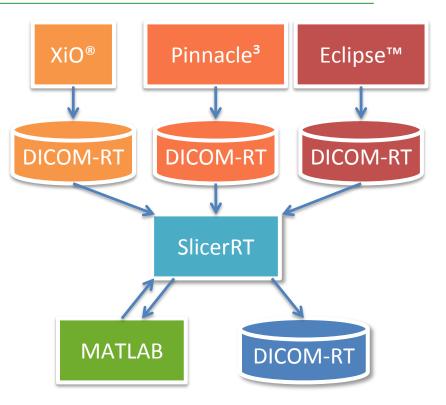
Development principles

 Leverage existing tools and parallel efforts: 3D Slicer¹, Plastimatch²

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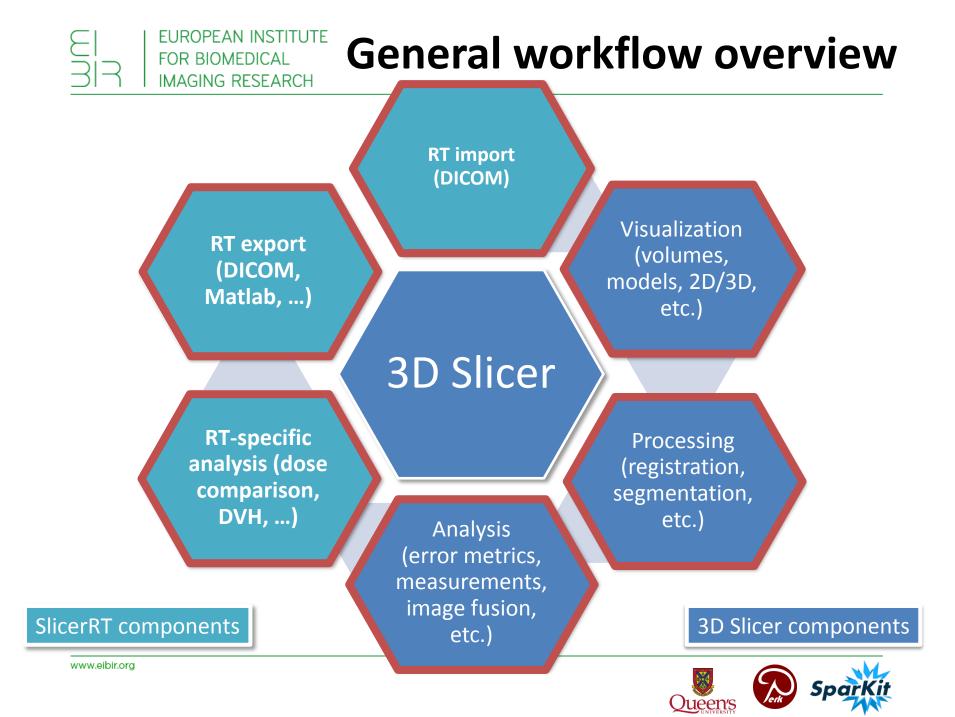
- "Hub" for RT data analysis and comparison
- Cover most common RT research workflows
- Free, open-source license (BSD)
- Open to integrate algorithms
- Extensive documentation



¹S. 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.

²G. 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).

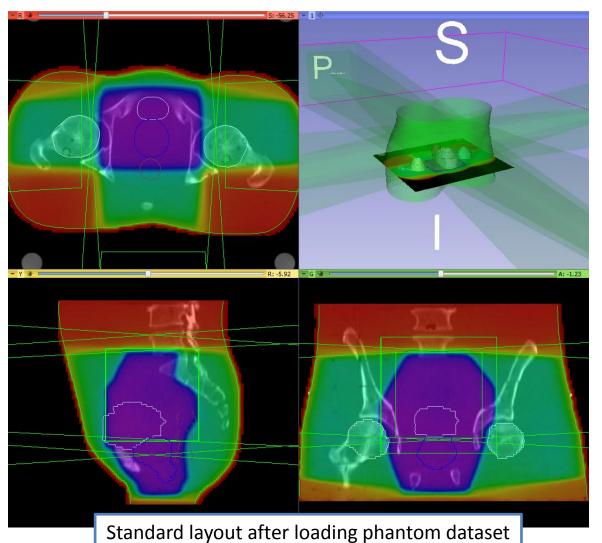




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DICOM-RT import

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

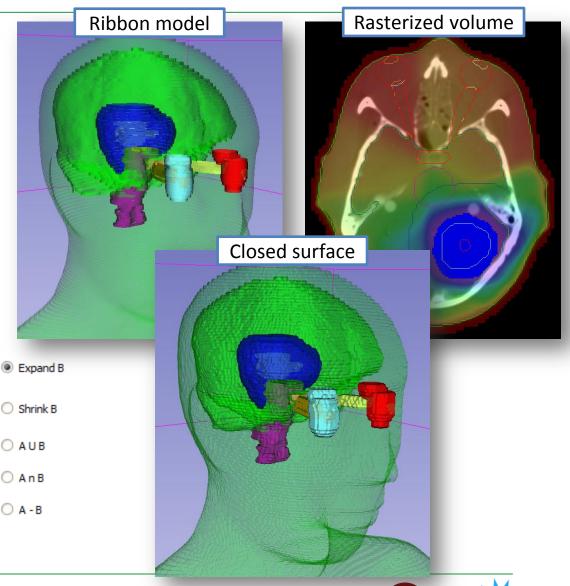




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Contour analysis

- 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

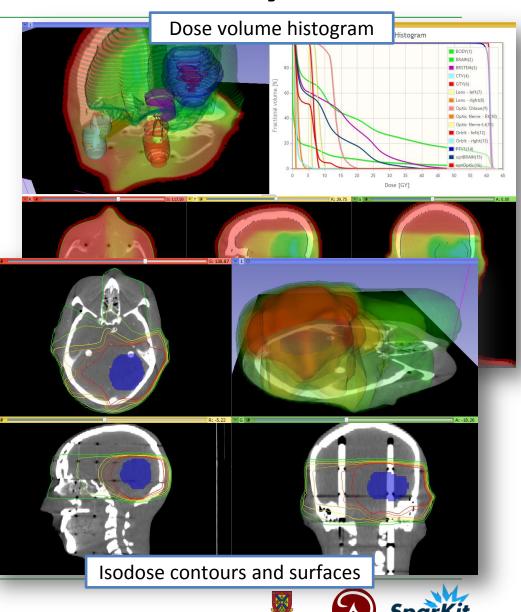


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Dose analysis

- 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



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Example use case

Use case: Evaluate the effectiveness of RT plan adaptation

Import, load and visualize data

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- 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

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2	PTV1	5_RTDOSE Accumu Rigid	lated 126.957	121.649	103.691	124.648	100.00	124.22	114.96
3	PTV1	5_RTDOSE Accumu BSpline	ulated 126.957	121.657	103.435	124.646	100.00	124.22	115.67
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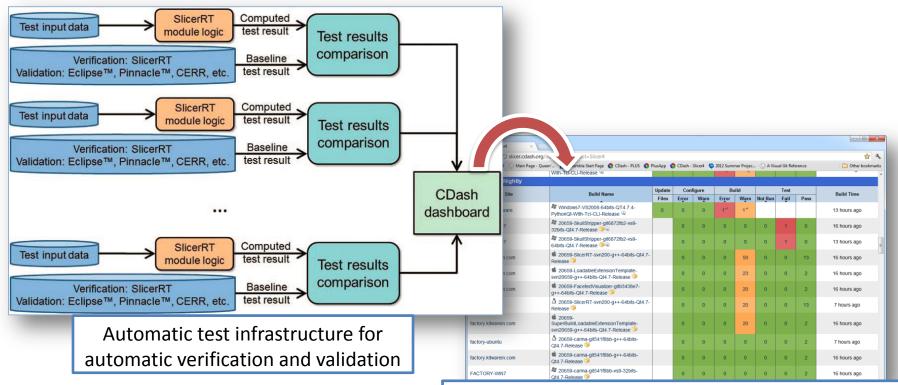


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Software quality

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



Test results reported to the web-based dashboard

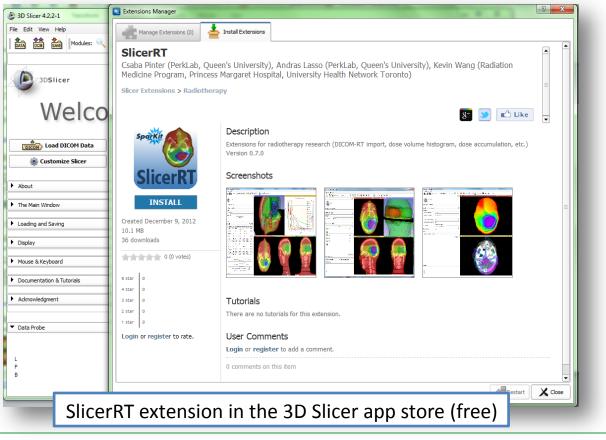
http://slicer.cdash.org/index.php?project=Slicer4





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





Next steps

Enhancements planned for the next 6 months:

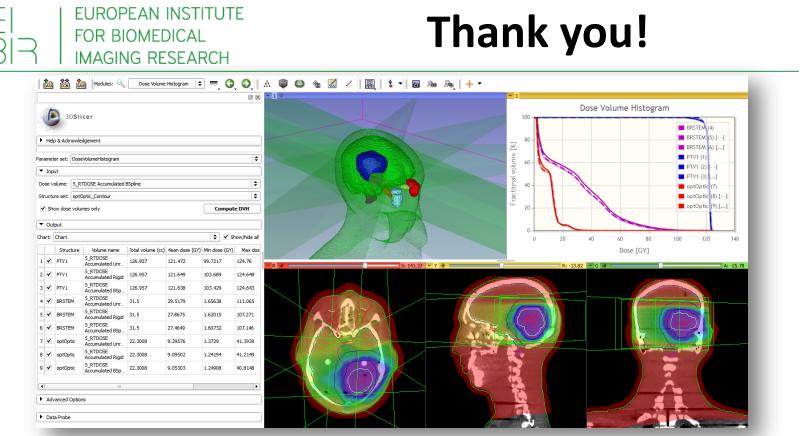
- DICOM-RT export
- Matlab bridge interface: execute Matlab functions from 3D Slicer
- Digitally reconstructed radiograph
- Support CERR PlanC format
- Scripting examples
- More testing and validation

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	Welcome to Slicer						
	Plastimatch	•					
	Radiotherapy	×.	Beams				
	Wizards	•	Contour Comparison				
	Informatics	•	Contour Morphology				
	Registration	•					
	Segmentation	•	Contours Dose Accumulation				
	Quantification	•					
	Diffusion	•	Dose Comparison				
	IGT	•	Dose Volume Histogram				
	Filtering	•	Isodose				
	Surface Models	•	Matlab Commander				
	Converters	•	Proton Dose				
	Endoscopy	•					
	Utilities	•					

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

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





- 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: <u>http://www.SlicerRT.org/</u>
- Contact: Csaba Pinter (<u>pinter@cs.queensu.ca</u>)

