The 3D Slicer open-source platform for segmentation, registration, quantitative imaging and 3D visualization of biomedical image data

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National Alliance for Medical Image Computing (NA-MIC)
Neuroimage Analysis Center (NAC)
Outline

- Slicer History
- Slicer Functionalities
- Clinical Applications
- Training Effort
INTRODUCTION
Slicer 19th year Anniversary

- 1997: Slicer started as a Master’s thesis between the Surgical Planning Lab (Harvard) and the Computer Science and Artificial Intelligence Laboratory (CSAIL) at MIT

- 2016: International open-source platform for medical image computing

P.I. Prof. Ron Kikinis, BWH, Harvard
3D Slicer

- Slicer is a freely available open-source application for viewing, analyzing and interacting with biomedical imaging data.
3DSlicer

- Slicer is a freely available open-source application for viewing, analyzing and interacting with biomedical imaging data

- Slicer is multi-platform and runs on Windows, Linux, and Mac
A multi-institutional effort
3D Slicer

- Slicer is distributed under a BSD license with no restriction on use

- Slicer is not FDA-approved nor CE-marked, and is for clinical research only
3D Slicer

Slicer can be used by clinical researchers on their own Mac, Windows or Linux laptops with their own data.

3D Slicer workshop, PLA General Hospital, Beijing
Slicer is built every night

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Slicer is under active development: built every night on every platform
Slicer4 Download Statistics

**Date range:** Nov 28, 2011 - Mar 8, 2016

**Version**
- 4.0 (8%)
- 4.1 (10%)
- 4.2 (15%)
- 4.3 (28%)
- 4.4 (28%)
- 4.5 (12%)

**Operating system**
- Linux (13%)
- Mac (18%)
- Windows (68%)

**Stability**
- nightly (20%)
- release (80%)

**Region**
- Northern America (53412)
- Western Europe (29454)
- Eastern Asia (24118)
- Southern Europe (19727)
- Eastern Europe (13168)
- Northern Europe (11937)
- South America (8499)
- Southern Asia (6834)
- Australia, New Zealand (4320)
- Western Asia (3847)
- South-Eastern Asia (3246)
- Central America (1748)
- Northern Africa (1596)
- Southern Africa (587)
- unknown (108)
- Caribbean (214)
- Eastern Africa (174)
- Central Asia (106)
- Others (102)

**Country**
- United States (45446)
- China (13674)
- Germany (12828)
- Italy (9649)
- Canada (7963)
- United Kingdom (7270)
- Spain (6542)
- France (6583)
- Japan (6332)
- India (4805)
- Poland (3993)
- Russian Federation (3979)
- Australia (2751)
- Brazil (2464)
- Netherlands (3199)
- South Korea (2774)
- Switzerland (2694)
- Austria (2516)
- Others (6788)

**Downloads per day**

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An interdisciplinary platform

An open-source environment for software developers

An end-user application for clinical investigators and scientists

A software platform that is both easy to use for clinical researchers and easy to extend for programmers
SLICER FUNCTIONALITIES
Core Functionalities

- Visualization
- Segmentation
- Registration
- Reconstruction
- Diffusion
- Image Guided Therapy
- Quantification
- Reporting
Core Functionalities

- Visualization
- Segmentation
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Core Functionalities

- Visualization
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- Diffusion
- Image Guided Therapy
- Quantification
- Reporting

Editor

EMSegmenter
Core Functionalities

- Visualization
- Segmentation
- Registration
- Reconstruction
- Diffusion
- Image Guided Therapy
- Quantification
- Reporting
Core Functionalities

- Visualization
- Segmentation
- Registration
- Surface Reconstruction
- Diffusion
- Image Guided Therapy
- Quantification
- Reporting
Core Functionalities

- Visualization
- Segmentation
- Registration
- Reconstruction
- Diffusion MRI
- Image Guided Therapy
- Quantification
- Reporting
Core Functionalities

- Visualization
- Segmentation
- Registration
- Reconstruction
- Diffusion
- Filtering
- Image Guided Therapy
- Quantification

Image Courtesy A. Fedorov, T. Penzkofer, R. Kikinis
Core Functionalities

- Visualization
- Segmentation
- Registration
- Reconstruction
- Diffusion
- Filtering
- Image Guided Therapy
- Quantification

Image Courtesy A.Fedorov, R.Kikinis
Slicer is Extensible

• Slicer is Extensible through plugins called Slicer Extensions

• The Slicer Extension Manager enables users to download + 70 additional Slicer modules
3D SLICER: APPLICATIONS

Image Courtesy A. Golby
Slicer applications

• Driving Biological Projects leading to the development of new tools

• Applied science oriented toward subject specific analysis in the presence of pathology
Slicer use in clinical research environment

- AMIGO, BWH, Boston, USA (DTI)
- Slicer RT – Canada
- Quantitative Image Network collaboration with German Cancer Research Institute (PET/CT)
Image-Guided Therapy Research at BWH: Open MRI (1991)
Image-Guided Therapy Research at BWH: AMIGO (2011)

Improving Patient Care with AMIGO
Advanced Multimodality Image Guided Operating Suite
AMIGO (2011-2016): +1,000 clinical cases
Image-guided therapy for prostate interventions:

- Brachytherapy Planning
- Navigation for Biopsy


Image Courtesy of Steven Haker, PhD and Clare Tempany, MD
Neurosurgical Intervention
3D SLICER: TRAINING
Slicer Training History: 2005-2016

- Training Core of two NIH-funded consortia: the National Alliance for Medical Image Computing (NA-MIC) and the Neuroimage Analysis Center (NAC) (P.I. Ron Kikinis)
3D Slicer Training

- Training effort to transfer scientific advances in medical image computing to clinical researchers
- Courses tailored for clinicians and scientists at national events, invited seminars, and international conferences
Slicer Trainees

- Clinical investigators
- Senior scientists
- Postdoctoral fellows
- Programmers
- Undergraduate and graduate students
- Staff researchers
- +3,500 trainees worldwide
Slicer Project Weeks

- Bi-annual week of hands-on programming
- Practical exchange of idea and experience
- 21 project weeks in the US since 2005
Conclusion

• Slicer is an open-source research platform for medical image analysis

• The Slicer community is an open community with contributors from all over the world

• Slicer is a versatile platform for translational research and subject specific analysis of biomedical image data
Acknowledgments

National Alliance for Medical Image Computing
NIH U54EB005149

Neuroimage Analysis Center
NIH P41RR013218