Implementing clinical applications using 3D Slicer (slicelets and guidelets)

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Right tool for the job

Can it be done?
Technological prototype: innovative, not robust, usually single developer supported

Should it be done?
Research tool: robust and usable enough for clinical evaluation, flexible, open, portable, community supported

Clinical tool
Patient ready: FDA approved, company supported, closed source
Customization options – Level 1

• Adding new **module**: adds new features to 3D Slicer, may contain new data types (MRML nodes), algorithms (logic class), user interface (widget class, displayable manager class)
• Adding new **extension**: package of related modules that users can install
3D Slicer in clinical use

- Radiation dose calculations
- MRI-guided prostate biopsy
- Breast cancer surgery guidance
- Diagnosis of Osteoarthritis Degeneration
- Quantitative assessment of COPD
- Surgical navigation
- Brain surgery
- Model-Guided Deep Brain Simulation
- Diagnosis of Different Tumors in Lung Cancer
- Tracking peritumoral white matter fibers

Clinical users drive creation of technology
Customization options – Level 2

- **Slicelet**: module that draws its entire user interface – it can run without creating a 3D Slicer main application window or hiding the main application window, can toggle between full Slicer GUI/simple GUI ([www.slicer.org/slicerWiki/index.php/Documentation/Nightly/Developers/Slicelets](http://www.slicer.org/slicerWiki/index.php/Documentation/Nightly/Developers/Slicelets))

- **Guidelet**: slicelet for interventional guidance applications – has built-in support for tool navigation, real-time imaging control (ultrasound), touch-optimized, workflow-based user interface ([www.slicerigt.org](http://www.slicerigt.org))

https://www.slicer.org/slicerWiki/index.php/Documentation/Nightly/Modules/GelDosimetry

http://www.slicerigt.org/wp/breast-cancer-surgery/
Known commercial activities range from use “as is” to full blown product development:

- Xstrahl (small animal radiation product)
- mebio (radiology product, prostate guidance)
- SonoVol (ultrasound product) (R43CA192482...)
- Novartis (quantitative imaging clinical trials)
- New Frontier (navigation system)
- KUKA (surgical robotics)
- Siemens (diagnostic and interventional research)
- Canon (robotic interventions)
- GE (research and products)
- NDI (trackers for surgical navigation)
- Isomics (research, consulting)
- Kitware (research, consulting)
  - 10+ Slicer based projects in the past two years
  - 5 commercial products being launched
Customization options – Level 3

**Custom application**: 3D Slicer installation packages can be built with customized branding and feature set – custom modules can be included, some default built-in modules excluded, custom application name, startup message, splash screen, startup module, user preferences, etc.

- Customization of existing binary package:

- Custom Slicer build:
System implementation overview

Guidelets/slicelets

Slicer extensions

SlicerIGT

LumpNav

GuideletLib

Model registration

Breach warning

Tool watchdog

SlicerRT

DICOM-RT import

Dose volume histogram

Dose comparison

3D Slicer

Visualization

Registration

Segmentation

Quantification

OpenIGTLink

DICOM

PLUS

Calibration, synchronization, pre-processing, simulation, record&replay

OpenIGTLink

Device interface

Surgical microscopes, endoscopes

Ultrasound scanners

Navigation systems

Robotic devices, manipulators

MRI, CT, PET scanners

hundreds of devices (imaging, position tracking, various sensors, and manipulators)

hardware

software

hundreds of devices (imaging, position tracking, various sensors, and manipulators)
Custom slicelet/guidelet code is around 0.01%
It is not a problem if it is complex, changing frequently, etc. – the application may still work very robustly.
Summary

- Customization options at several levels, they may be all combined
- Very small amount of custom code need to be developed, changed, maintained.

PerkLab: [http://perk.cs.queensu.ca](http://perk.cs.queensu.ca)
3D Slicer: [www.slicer.org](http://www.slicer.org)