SlicerIGT: Open-source platform for image-guided needle interventions

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Introduction

- Image-guided interventions with tracking and computerized navigation are a powerful combination that allows safe and minimally invasive therapeutic procedures.
- Interventional navigation systems require high quality, reusable software for incremental development.
- Our goal was to provide an open-source, easily configurable software toolkit, named SlicerIGT that contains all components for a typical image-guided navigation system.

Methods

System overview

- SlicerIGT software architecture (Fig. 1.) is shown in the context of tracked ultrasound-guided needle interventions.
- SlicerIGT is an extension of the 3D Slicer application (www.slicer.org), accessible from the 3D Slicer Extension Manager. SlicerIGT uses 3D Slicer features, and hardware communication interface software, e.g., PLUS (www.plustoolkit.org).

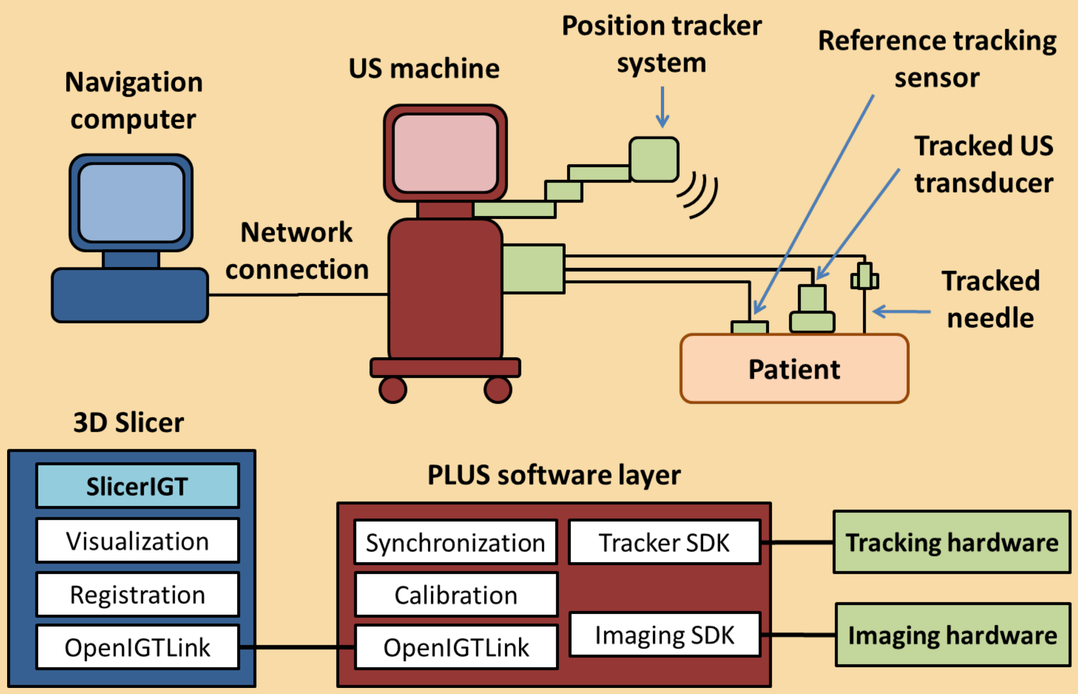

Figure 1. Hardware configuration (top) and software architecture (bottom) of an ultrasound-guided needle navigation system using SlicerIGT

Development process

- Quality assurance by automatic nightly tests on Windows, Mac, and Linux, using the common 3D Slicer extension testing infrastructure.
- Source code, issue tracking, and documentation maintained by the developer community on an open-source public repository. The project website provides open access to auxiliary information, sample data, CAD models, phantom making recipes, user guides, and more.
- SlicerIGT is available under BSD license, which allows reuse and modifications (research and commercial) without restrictions. New users and developers are encouraged to join.

Project websites

- **www.slicerigt.org**
- **www.plustoolkit.org**
- **www.slicer.org**

Results

Modules of SlicerIGT

- **Collect Fiducials:** Creates fiducial points from real-time tracking of pointers for landmark-based registration.
- **Create Models:** Creates simple shape models to represent tracked objects when a CAD model is not available.
- **OpenIGTLink Remote:** Controls hardware communication interface applications (e.g., PLUS) through OpenIGTLink network messages.
- **Ultrasound Snapshots:** Creates snapshots with the position and content of a real-time tracked image. This enables e.g., the decoupling of ultrasound imaging and needle insertion in time.
- **Volume Reslice Driver:** Enables real-time visualization of tracked images by updating the position of 2D image slices.

Some applications of SlicerIGT

- Augmented reality image overlay needle guidance
- Facet joint injections guided by tracked ultrasound snapshots (Fig. 2/A)
- Perk Tutor: Training platform for ultrasound-guided interventions (Fig. 2/B.)
- Spinal fusion surgery planning and navigation (Fig. 2/C)
- Ultrasound-guided percutaneous kidney intervention navigation (Fig. 2/D

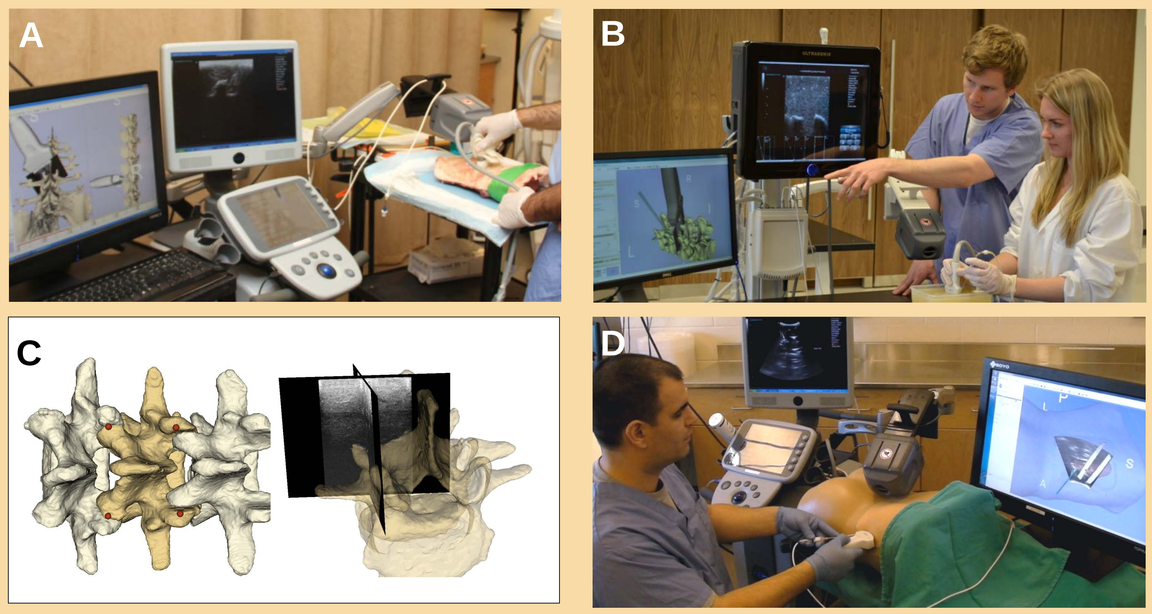

Figure 2. Applications of the SlicerIGT platform.

Conclusion

Advantages of building on the open-source SlicerIGT platform include:

- Reliable and maintainable software with minimal programming effort
- Advanced modules by other research groups are readily available
- New ideas can be implemented as modules, rather than new applications

These advantages outweigh the initial investment of learning a new research and software development environment.

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