Slicer3 Training Tutorial
Image overlay guided needle insertion using 3D Slicer (PERK Station)
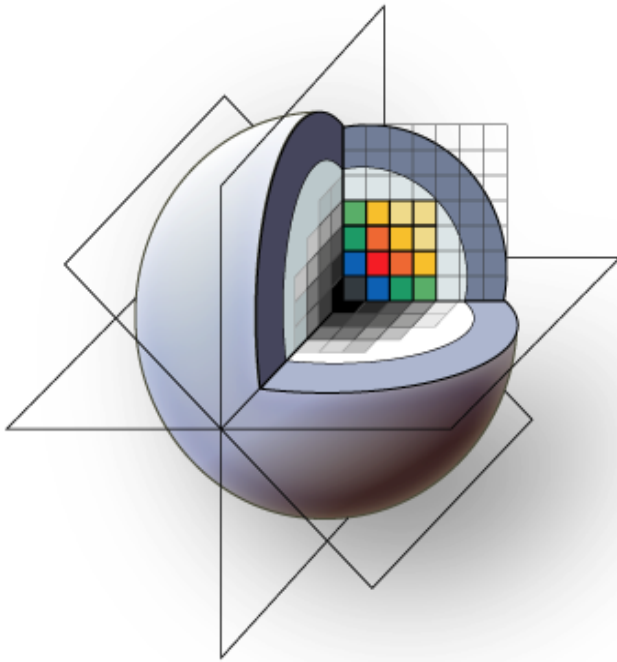
Queen's University
Johns Hopkins University

Tamas Ungi, Andras Lasso, Paweena U-Thainual,
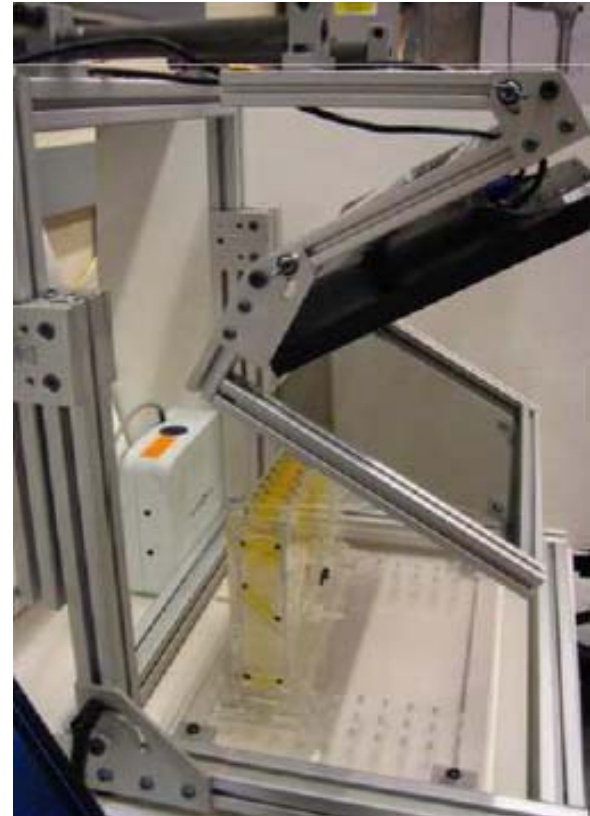Siddharth Vikal, Iulian Iordachita, Gabor Fichtinger

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3DSlicer

This tutorial demonstrates how to perform an image overlay guided needle insertion using 3D Slicer.

It is **not necessary** to have access to a PERK Station hardware, or any other image overlay system to complete the tutorial.

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This tutorial assumes that you have already completed the tutorial **Data Loading and Visualization**. Tutorials for Slicer3 are available at:

http://www.slicer.org/slicerWiki/index.php/Slicer3.4:Training

A PERK Station hardware is needed to perform real needle insertions. Reproducible CAD designs, assembly instructions will be available at:

http://www.na-mic.org/Wiki/index.php/DBP2:JHU:PerkStation

If you don't have a PERK Station hardware, the software will still run, and all the functions can be tested/learned.

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Get the PerkStation Module

PerkStationModule is not part of the core modules, but an external loadable module. Installation of Slicer3 will not show this module in the modules list.

To show PerkStationModule in the modules list, install Slicer3 first, then copy the PerkStationModule.dll file in \SLICER_INSTALL_DIR\lib\Slicer3\Modules

Get the PerkStation Module

Slicer3 installer can be downloaded from

http://www.slicer.org/pages/Downloads/

PerkStationModule source code can be checked out:

http://svn.na-mic.org/NAMICSandBox/trunk/Queens/PerkStationModule/

After build of PerkStationModule, copy the PerkStationModule.dll file to \SLICER_INSTALL_DIR\lib\Slicer3\Modules.

PerkStationModule will show up in the modules drop down list.

This assumes that the dll file was build in the same configuration as was Slicer3.

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Tutorial dataset is in a file: PerkStationTutorialDataset.zip

http://www.na-mic.org/Wiki/index.php/DBP2:JHU:PerkStation

Unzip the folder.

Plan.dcm contains a slice from an MR acquisition of a spine phantom.

Disclaimer: It is the responsibility of the user of Slicer to comply with both the terms of the license and with the applicable laws, regulations, and rules.
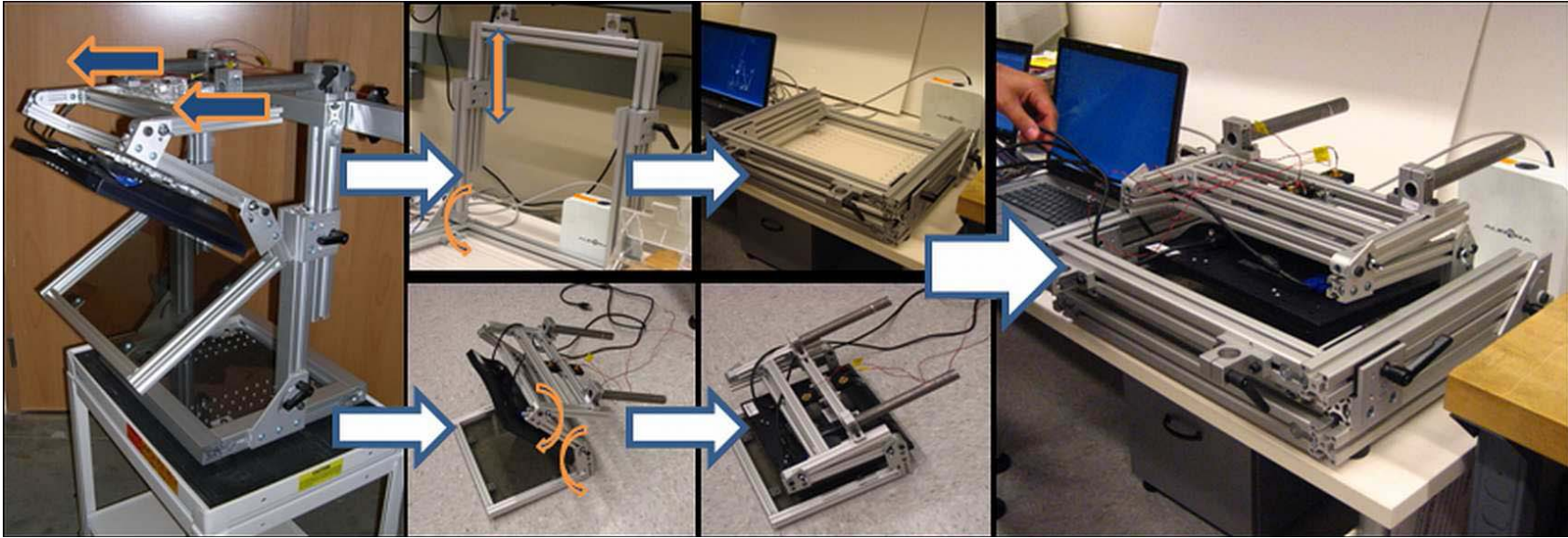
- Image guided percutaneous needle interventions, eg.
  - Tumor biopsy
  - Neurological pain management
  - Tissue ablations
- Reduce time and limitations of training under senior supervision
- Integrate three popular assistance techniques in one system
- Phantom provides a means for objective assessment across trainees
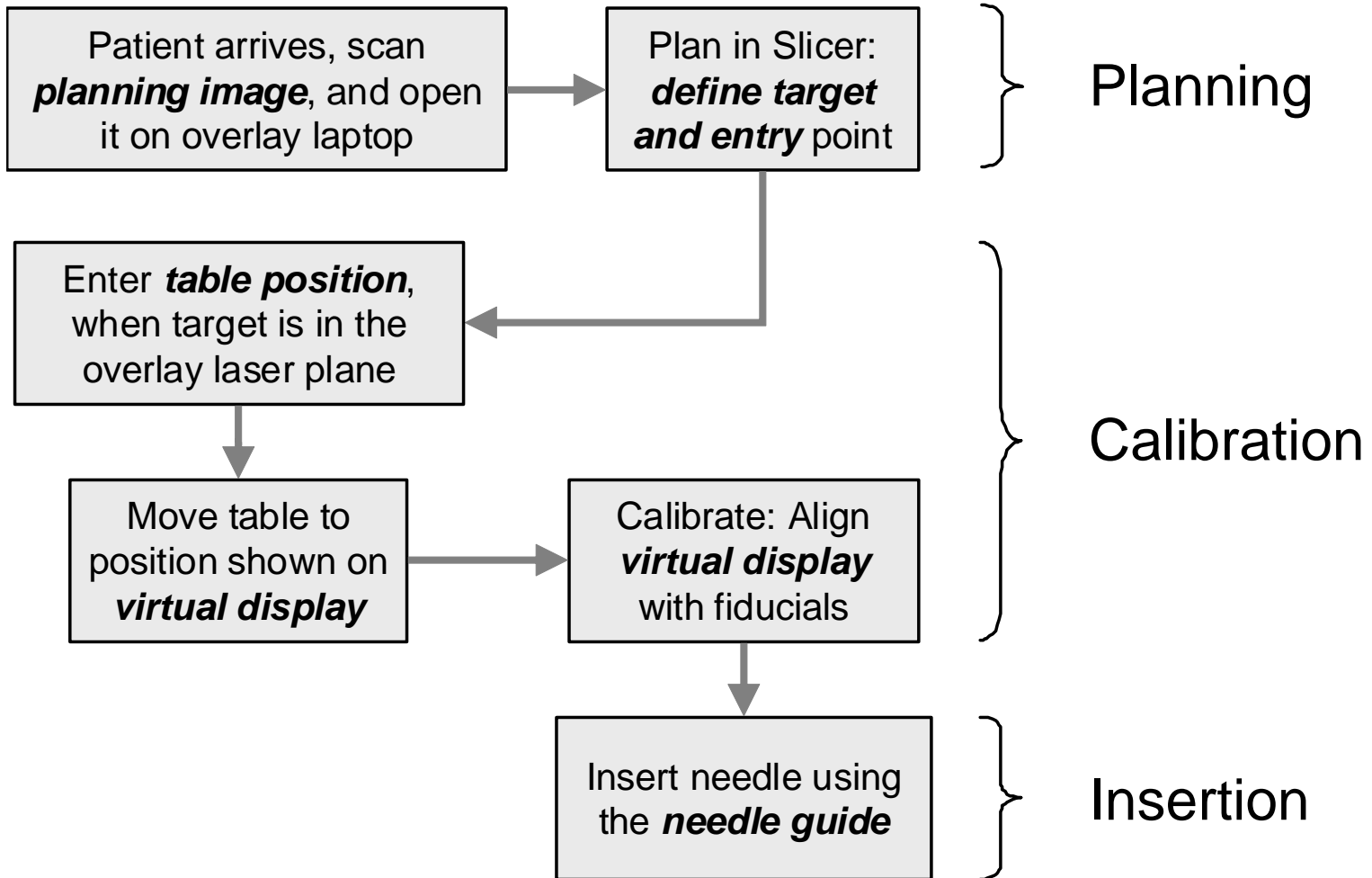
Perk Station portable hardware

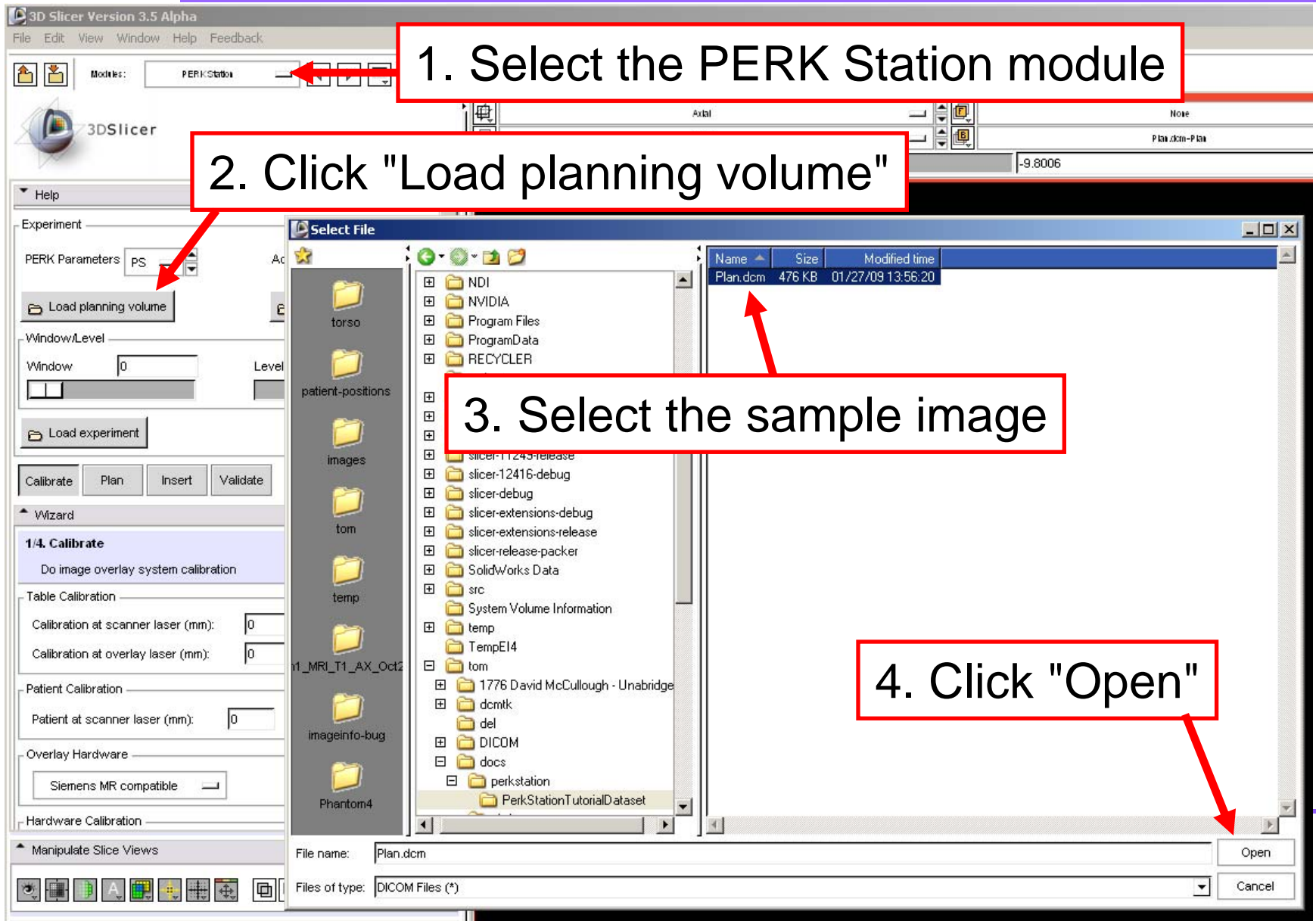Structure: Extruded aluminium frame, weights 16.5 kg.

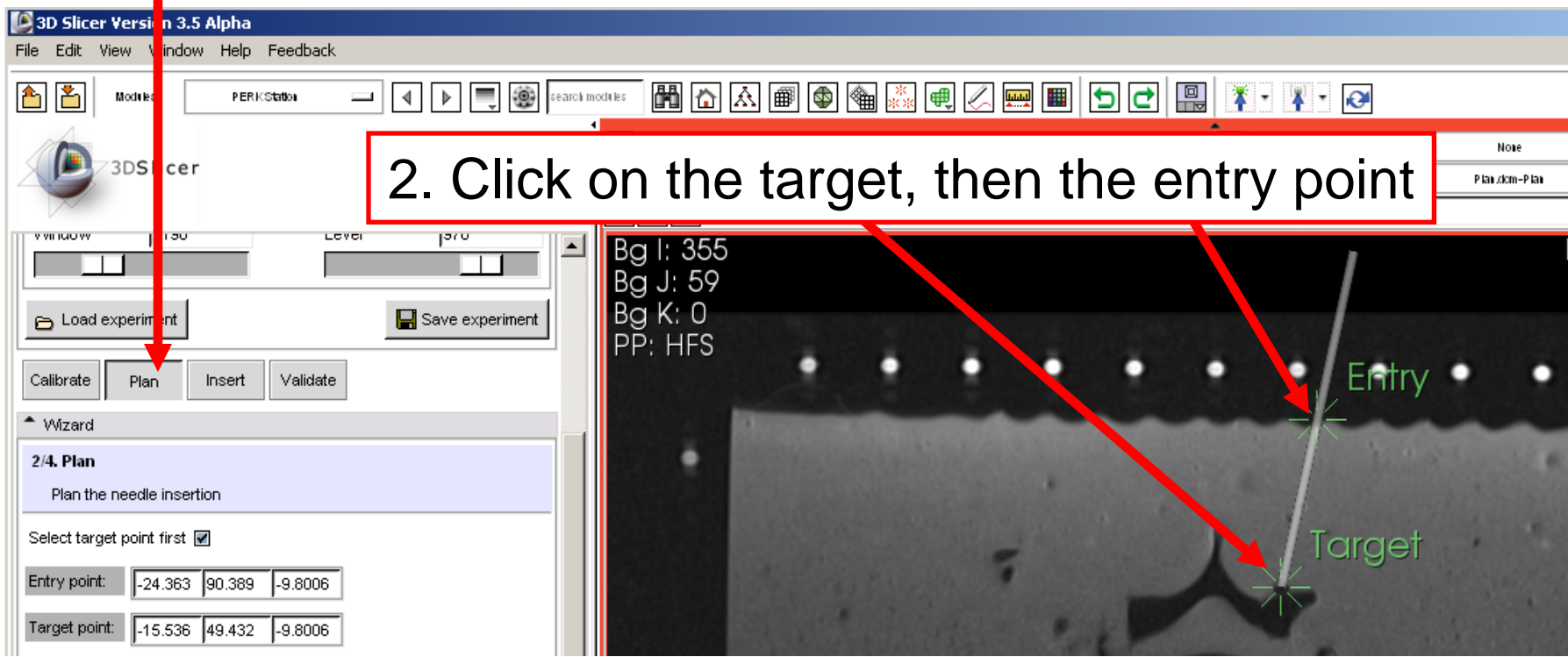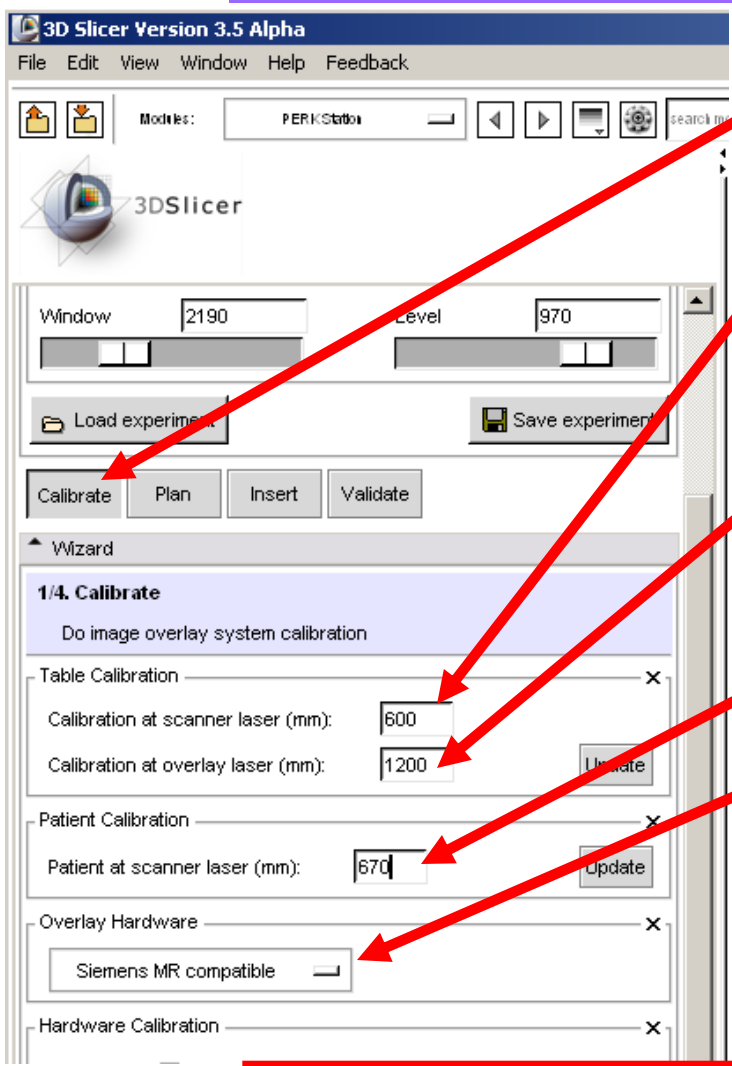Dimensions: 57 x 55 x 29 cm.

Intervention workflow overview

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```
┌─────────────────────┐      ┌─────────────────────┐
│ Patient arrives, scan│      │   Plan in Slicer:   │
│ planning image, and  │ ───> │   define target     │   } Planning
│ open it on overlay   │      │   and entry point   │
│      laptop          │      │                     │
└─────────────────────┘      └─────────────────────┘
```

Patient arrives, scan **planning image**, and open it on overlay laptop → Plan in Slicer: **define target and entry** point } **Planning**

Enter **table position**, when target is in the overlay laser plane

Move table to position shown on **virtual display** → Calibrate: Align **virtual display** with fiducials } **Calibration**

Insert needle using the **needle guide** } **Insertion**

Open the planning image

1. Select the PERK Station module

2. Click "Load planning volume"

3. Select the sample image

4. Click "Open"

Plan the insertion

Calibration

1. Select the Calibrate workphase

2. Enter the table position value when the calibration object is under the scanner laser.

3. Enter the table position value when the calibration object is under the overlay hardware laser.
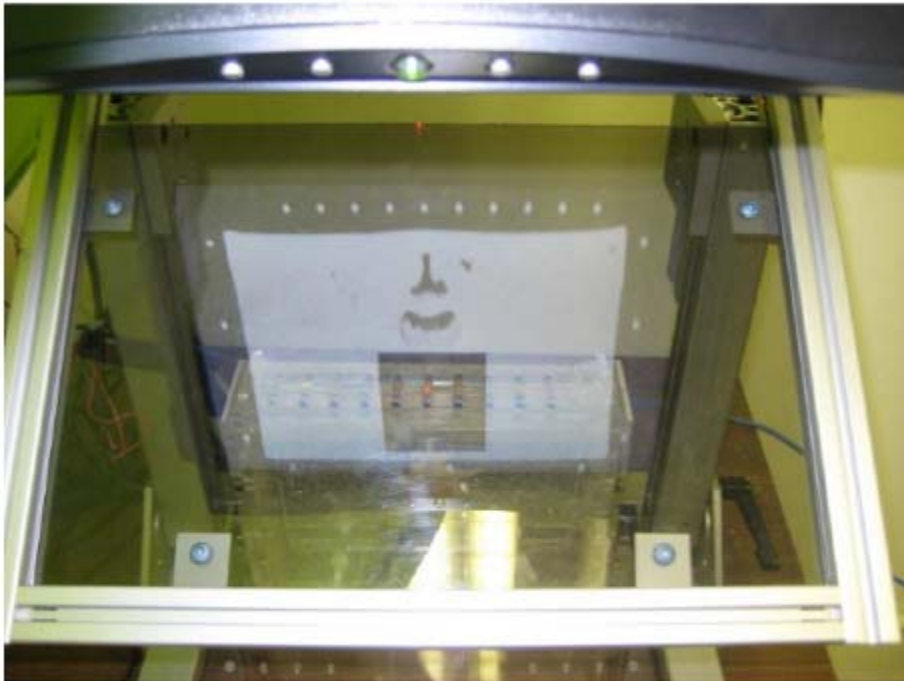
4. Enter the table position value when patient target is under the scanner laser.

5. Select the overlay hardware type.

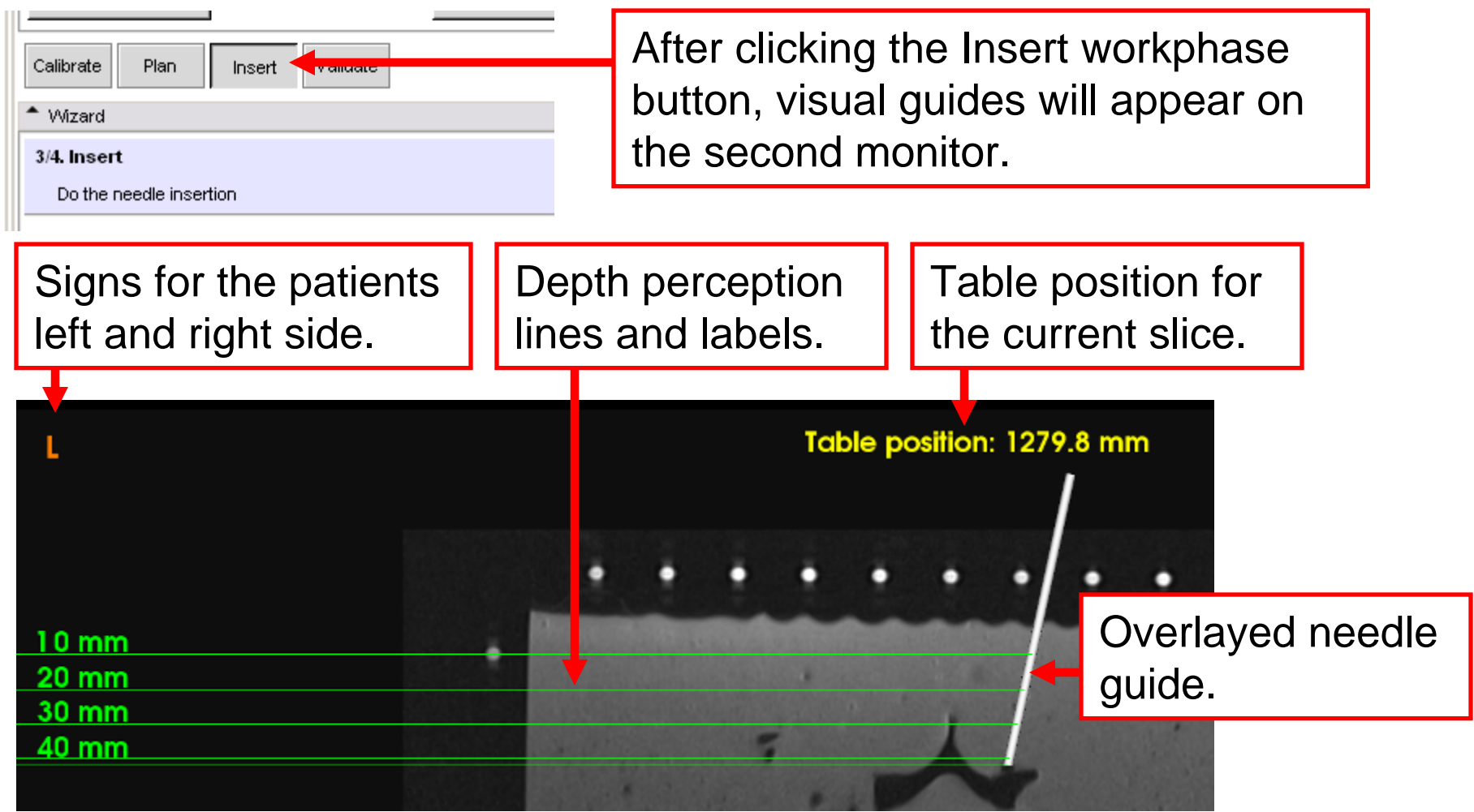To align overlayed image to the patient/phantom, follow instructions on the second monitor.

Note: Without an overlay hardware, you can leave default values in these fields.

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Overlayed image before alignment.

Overlayed image after alignment.

Insertion

Calibrate | Plan | Insert | Validate

Wizard

3/4. Insert

Do the needle insertion

After clicking the Insert workphase button, visual guides will appear on the second monitor.

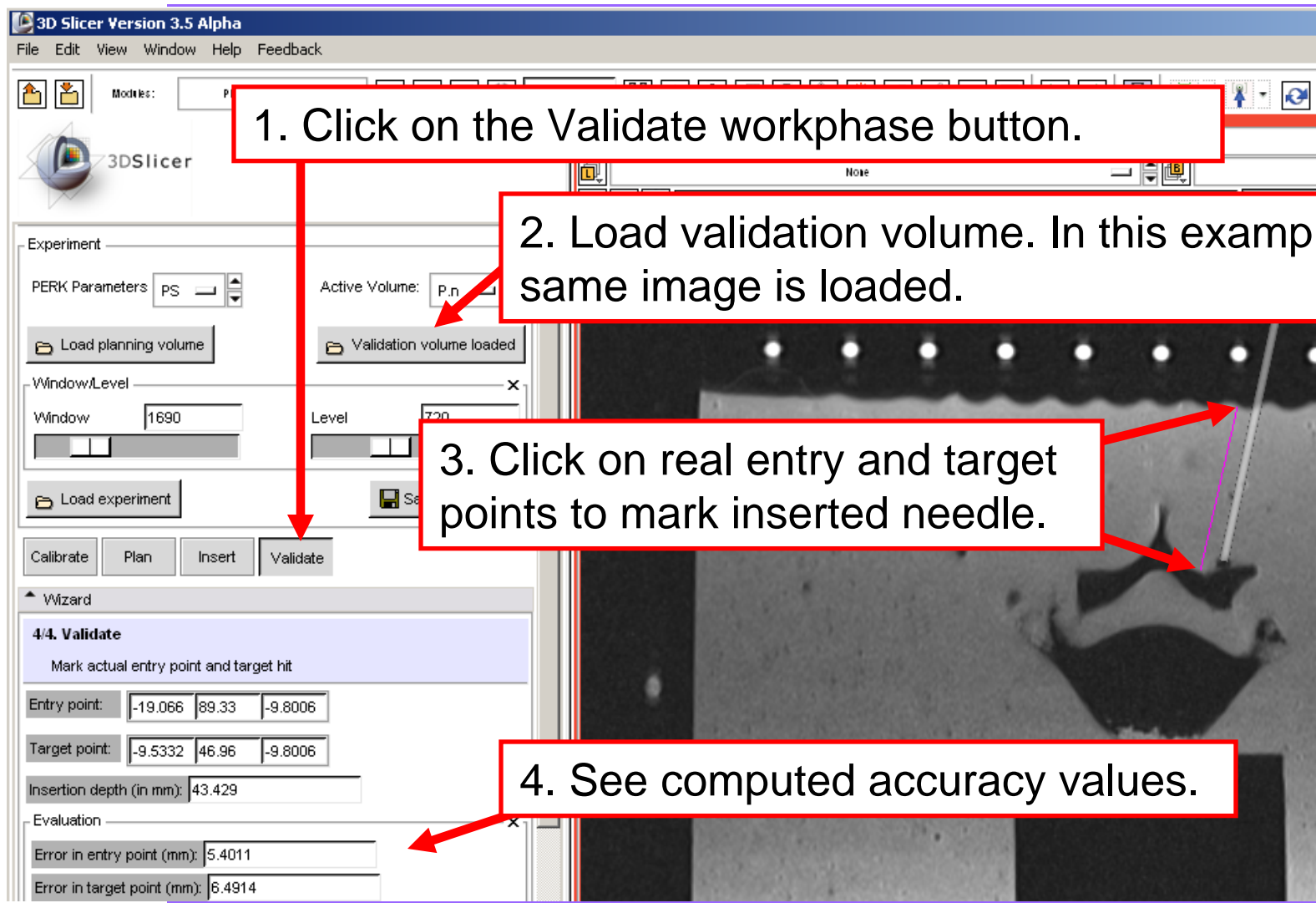Signs for the patients left and right side.

Depth perception lines and labels.

Table position for the current slice.

L

Table position: 1279.8 mm

10 mm
20 mm
30 mm
40 mm

Overlayed needle guide.

1. Click on the Validate workphase button.

2. Load validation volume. In this example, the same image is loaded.

3. Click on real entry and target points to mark inserted needle.

4. See computed accuracy values.

Outreach activities, teaching tool

Perk Station has debuted as undergraduate course teaching aid, and has received a huge response. Besides, it is being used in outreach events, to attract young minds to science.

3DSlicer

- A training and performance evaluation system in needle based surgical guidance applications is introduced and presented.

- Intuitive graphical user interface is developed.

- Open-source environment.

More information

Detailed information about the PERK Station:

1. Vikal, S., P. U-Thainual, J. Carrino, I. Iordachita, G. Fischer, and G. Fichtinger, "Perk Station-Percutaneous surgery training and performance measurement platform", Computerized Medical Imaging and Graphics, June 2009.

2. U-Thainual, P., G. Fischer, I. Iordachita, S. Vikal, and G. Fichtinger, "The Perk Station: Systems design for percutaneous intervention training suite", Procedings IEEE International Conference on Robotics and Biomimetics ROBIO 2009, pp. 1693–1697, 22–25 Feb, 2009.

3. U-Thainual, P., I. Iordachita, S. Vikal, and G. Fichtinger, "Teaching Aid for Computer-Assisted Surgery", Eastern Ontario Symposium for Educational Technology, 2009.

4. U-Thainual, P., I. Iordachita, and G. Fichtinger, "The Perk Station: Design of a percutaneous intervention training suite", 20th International Conference of the Society for Medical Innovation and Technology (SMIT), Vienna, Austria, August 28-31, pp. 148-153, 08/2008.

Acknowledgements

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