Image overlay guided needle insertion using 3D Slicer

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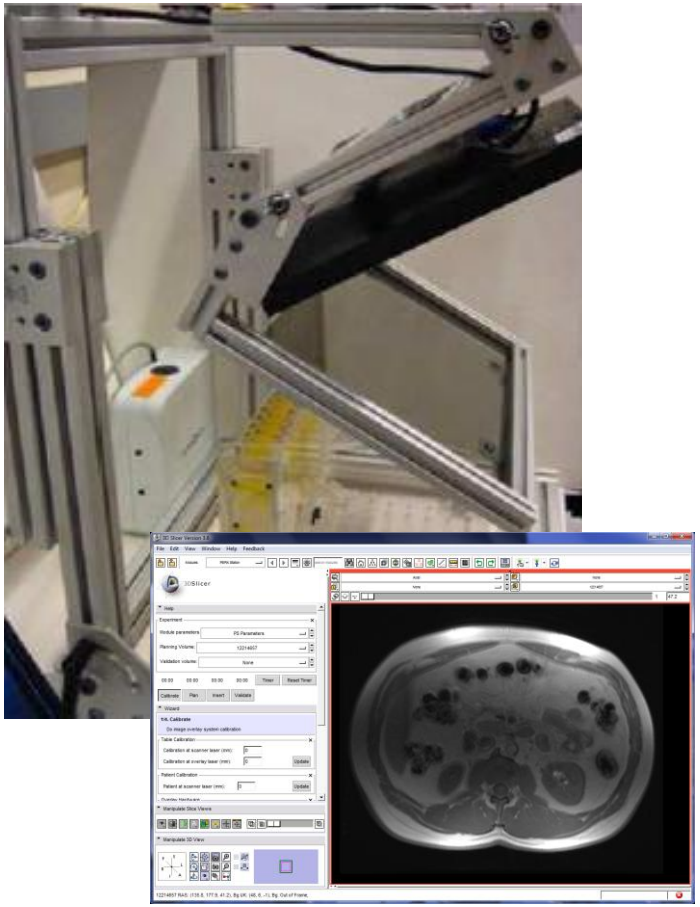
Learning Objective

This tutorial demonstrates how to perform 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.



Pre-requisite

- This tutorial assumes that you have already completed the **Slicer3Visualization Tutorial** (by Sonia Pujol)

- The tutorial is available at: **http://www.slicer.org/slicerWiki/index.php/Slicer3.6:Training**

Material

- This tutorial requires the installation of the **Slicer3.6 release** and the tutorial dataset. They are available at the following locations:
- **Slicer3.6** download page

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

- **Tutorial dataset**: PerkStationData_TutorialContestSummer2010

http://wiki.na-mic.org/Wiki/index.php/File:PerkStationData_TutorialContestSummer2010.zip

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.*

Platform

- The tutorial has been developed and tested on Windows XP and Windows 7 platforms.

Installation

- 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 the downloaded tutorial dataset package) into \SLICER_INSTALL_DIR\lib\Slicer3\Modules

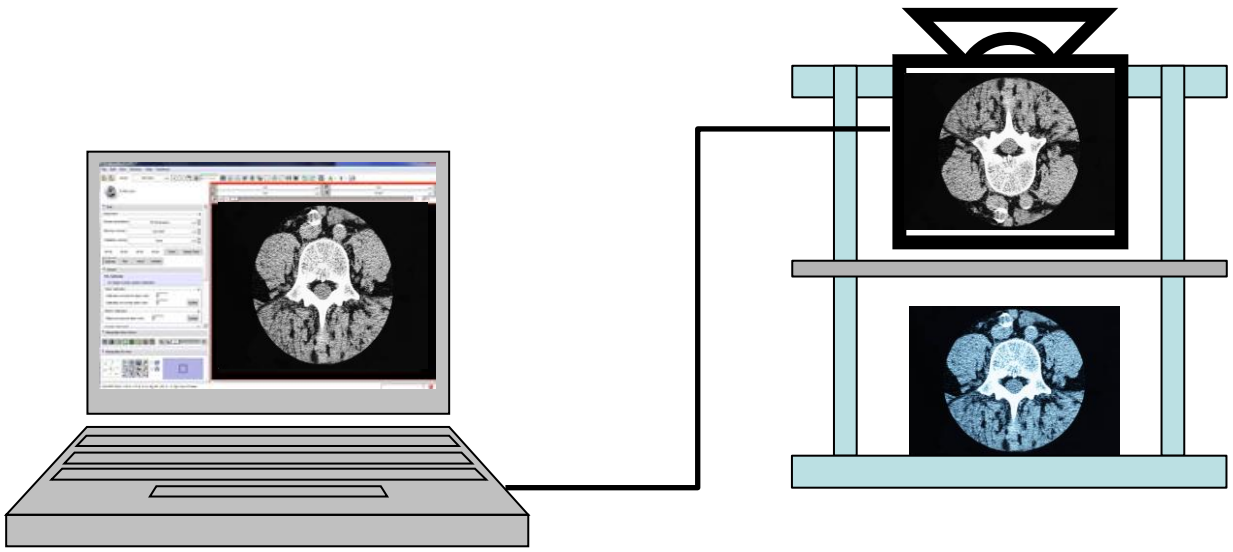
Overview

- Clinical background
- Systems overview
- Clinical workflow
  - Calibration
  - Planning
  - Insertion
  - Verification
- Conclusion

Clinical Background

- For image guided needle interventions, e.g.
  - Tumor biopsy
  - Neurological pain management
  - Tissue ablations
- Perk Station reduces time and limitations of training under senior supervision.
- Integrates three popular assistance techniques in one system (Image overlay, laser overlay, freehand).
- Phantom provides a means for objective assessment across trainees.

Systems overview



External monitor

Semi-transparent mirror

Phantom

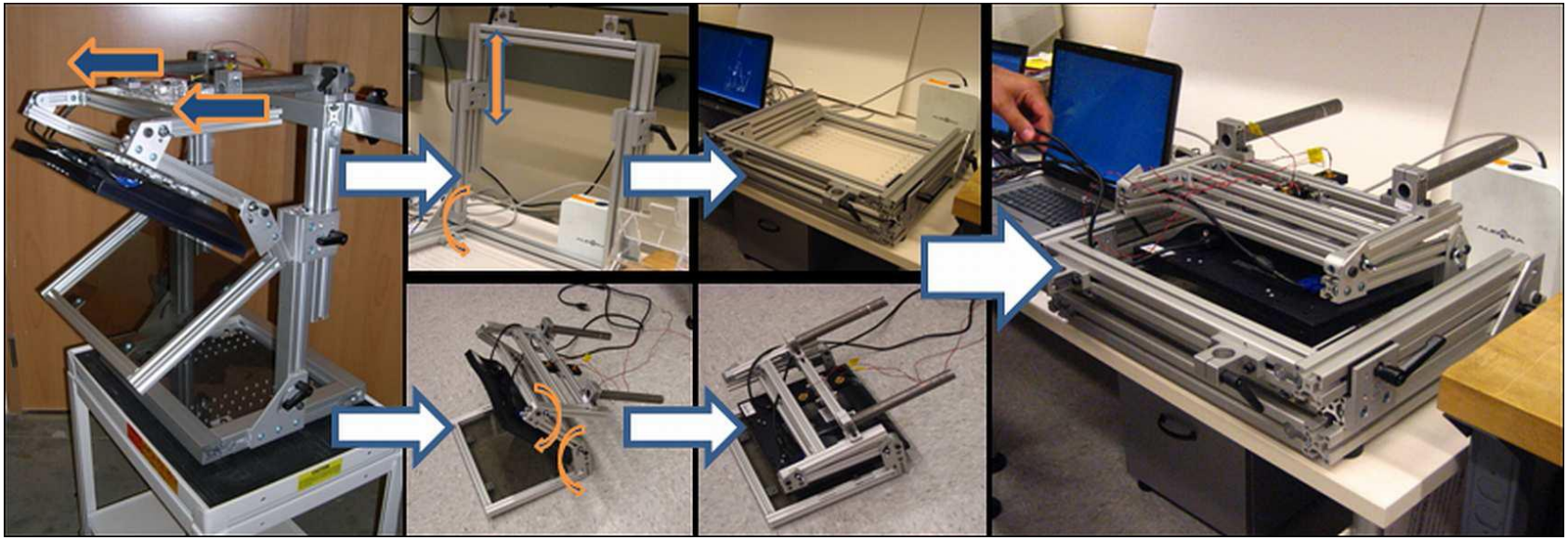
Computer running Slicer

Perk Station

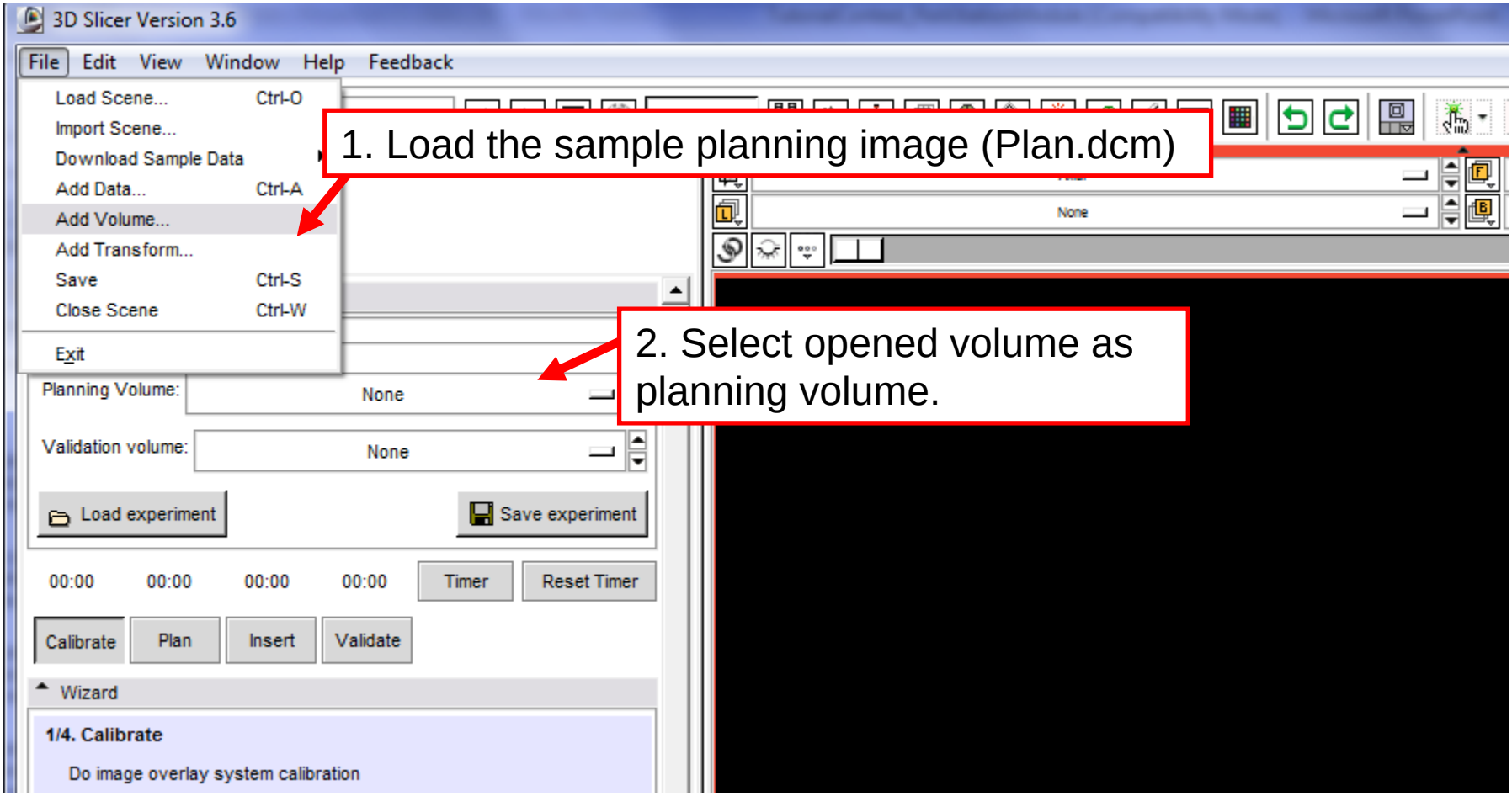
Perk Station hardware

Structure: Extruded aluminum frame, weights 16.5 kg.

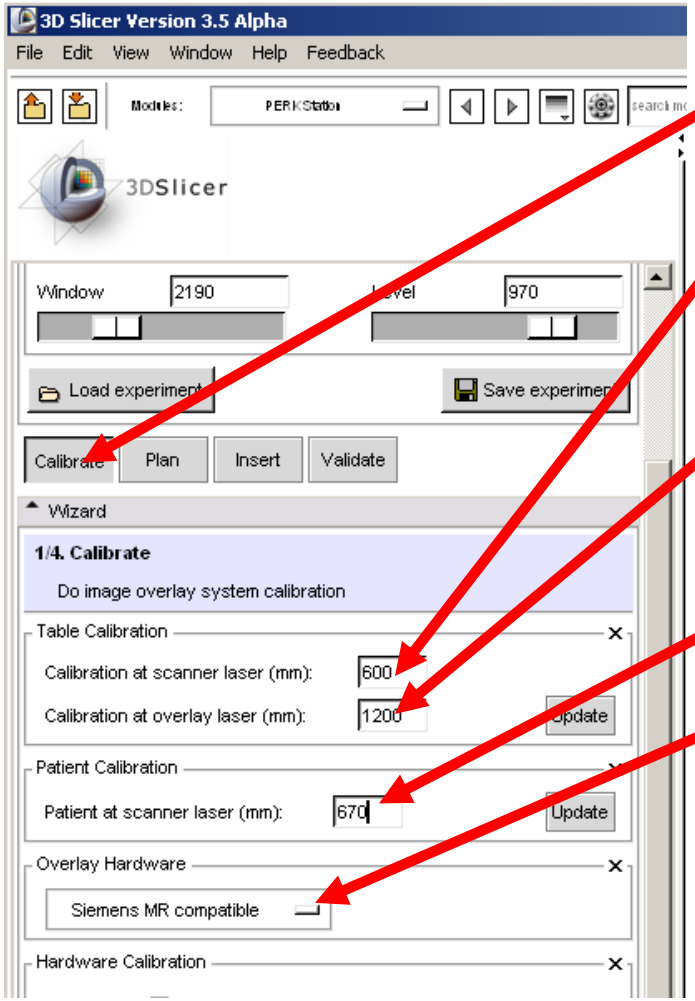
Dimensions: 57 x 55 x 29 cm.



Open the planning image



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 laser.

4. Enter the table position value when patient target is under the scanner laser.

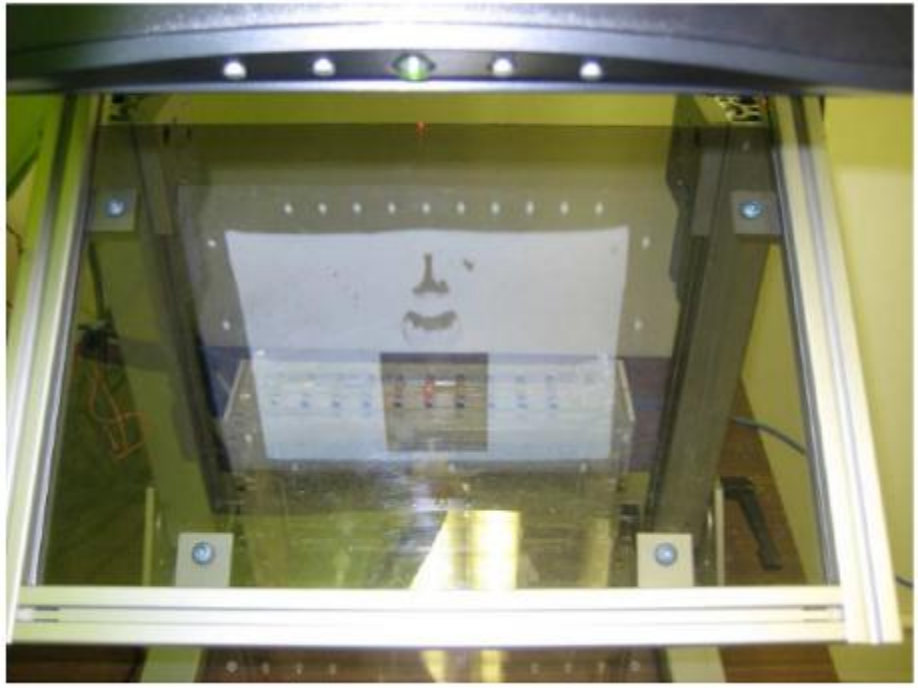
5. Select the overlay hardware type.

Follow instructions on the second monitor.

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

Calibration

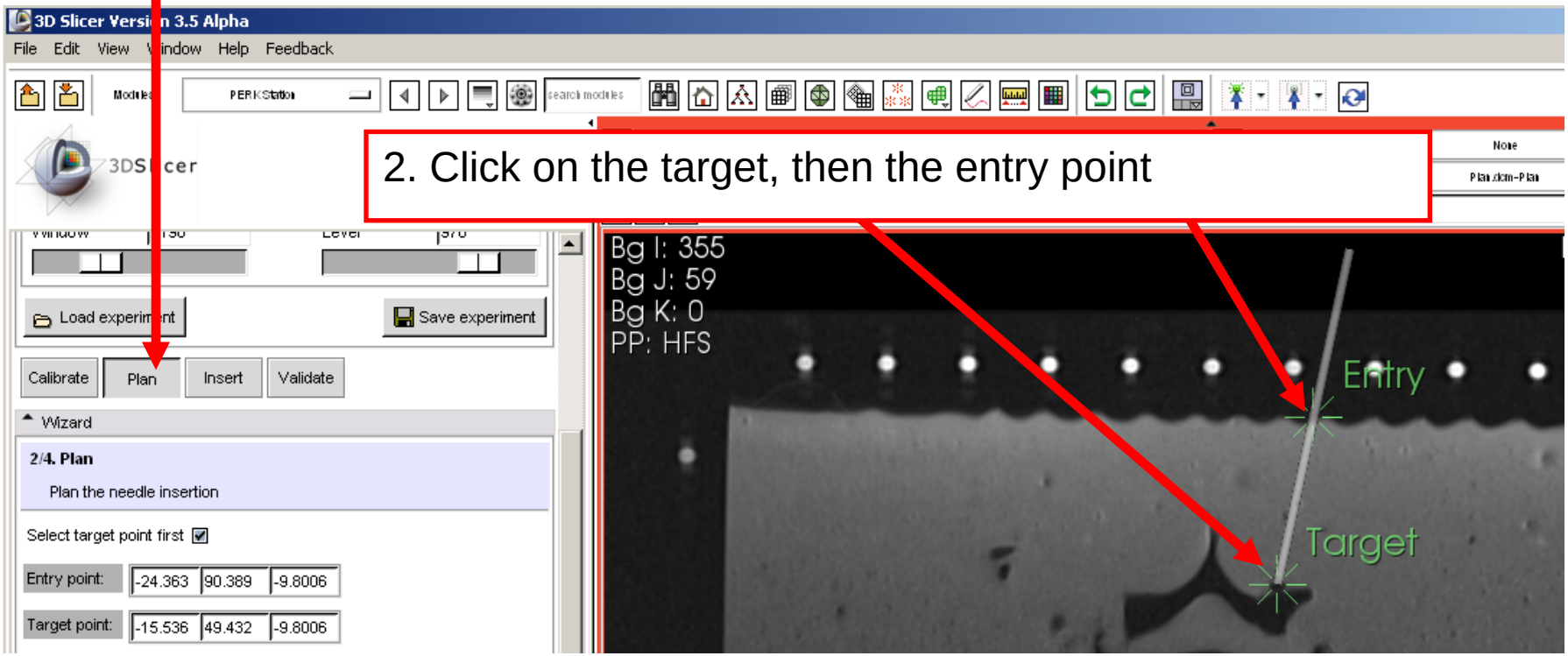
Overlayed image before alignment.



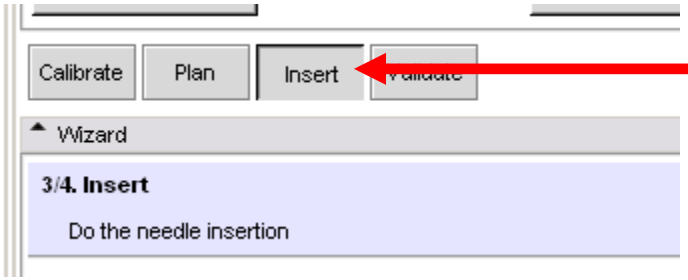
Overlayed image after alignment.

Planning

1. Select the Plan workphase



Insertion

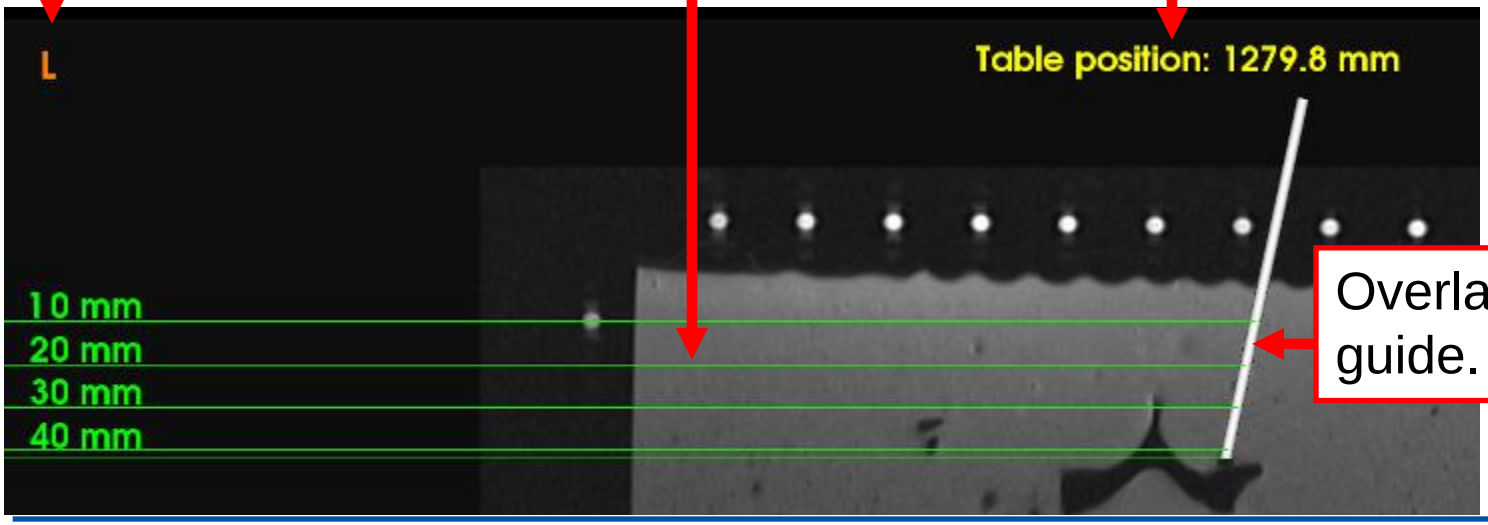


After clicking the Insert workphase button, visual guides will appear on the second monitor.

Signs for the patients left and right side.

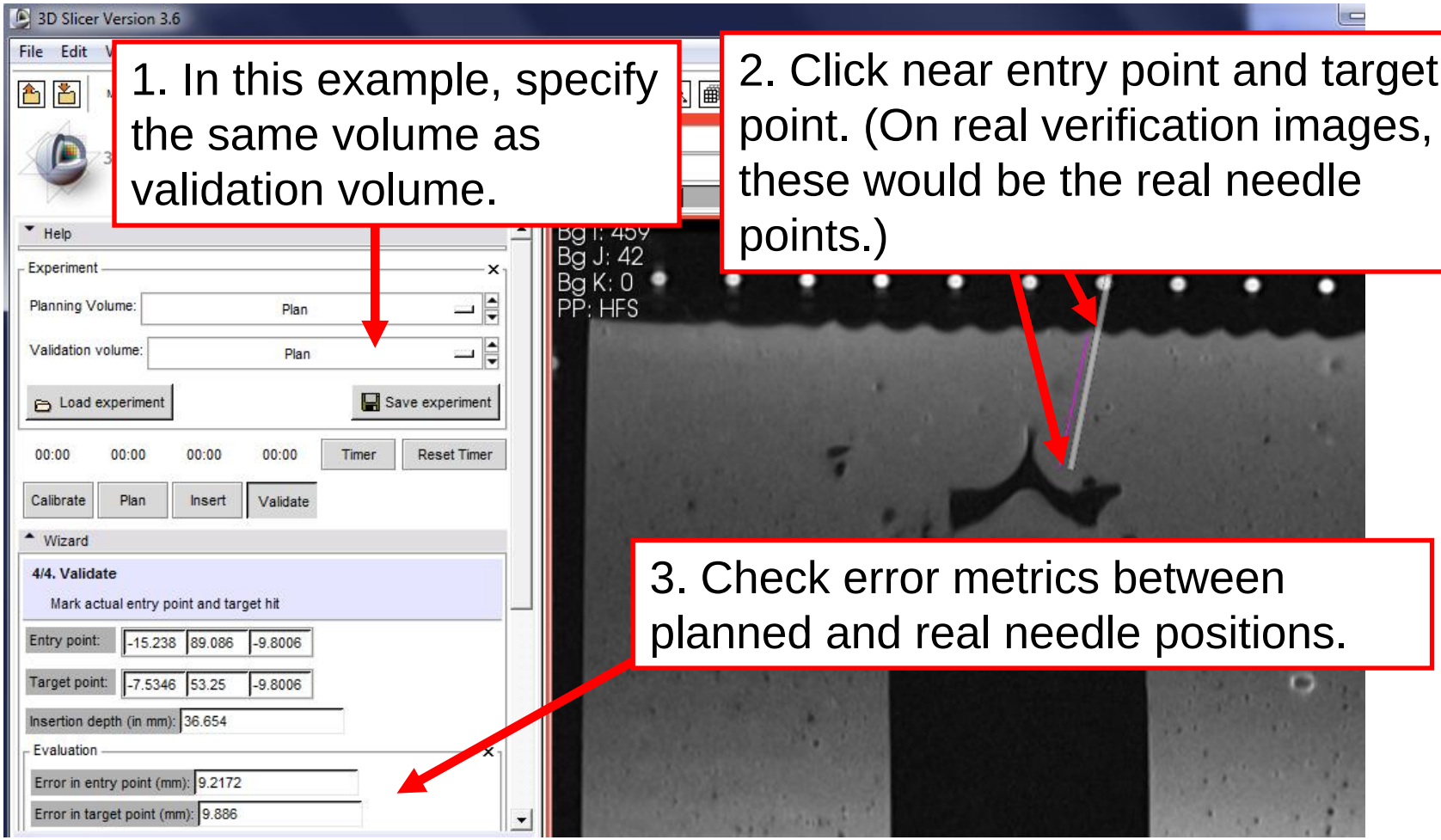
Depth perception lines and labels.

Table position for the current slice.



Overlayed needle guide.

Verification



1. In this example, specify the same volume as validation volume.

2. Click near entry point and target point. (On real verification images, these would be the real needle points.)

3. Check error metrics between planned and real needle positions.

Conclusion

- 3D Slicer with PerkStationModule and a reproducible hardware component allows planning and performing image-overlay guided needle insertions.
- A training and performance evaluation system is introduced and presented.

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