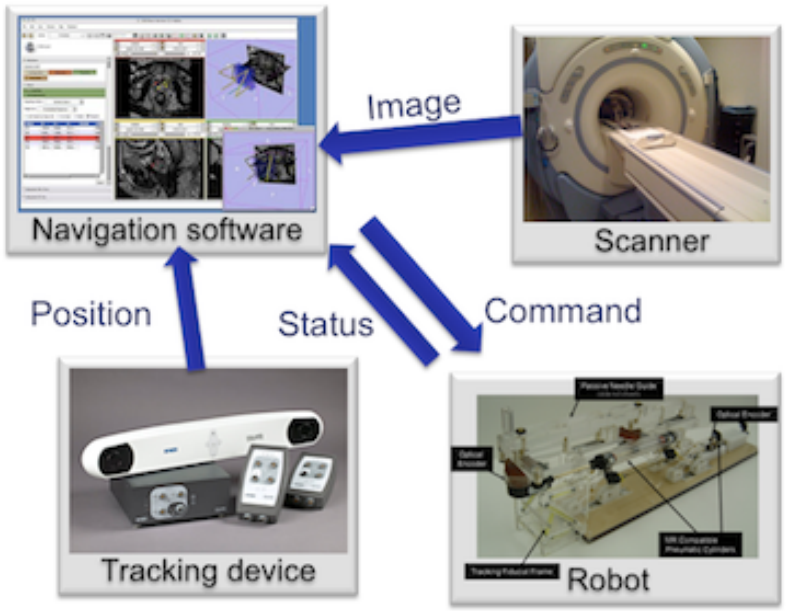
Connecting IGT Device with OpenIGTLink

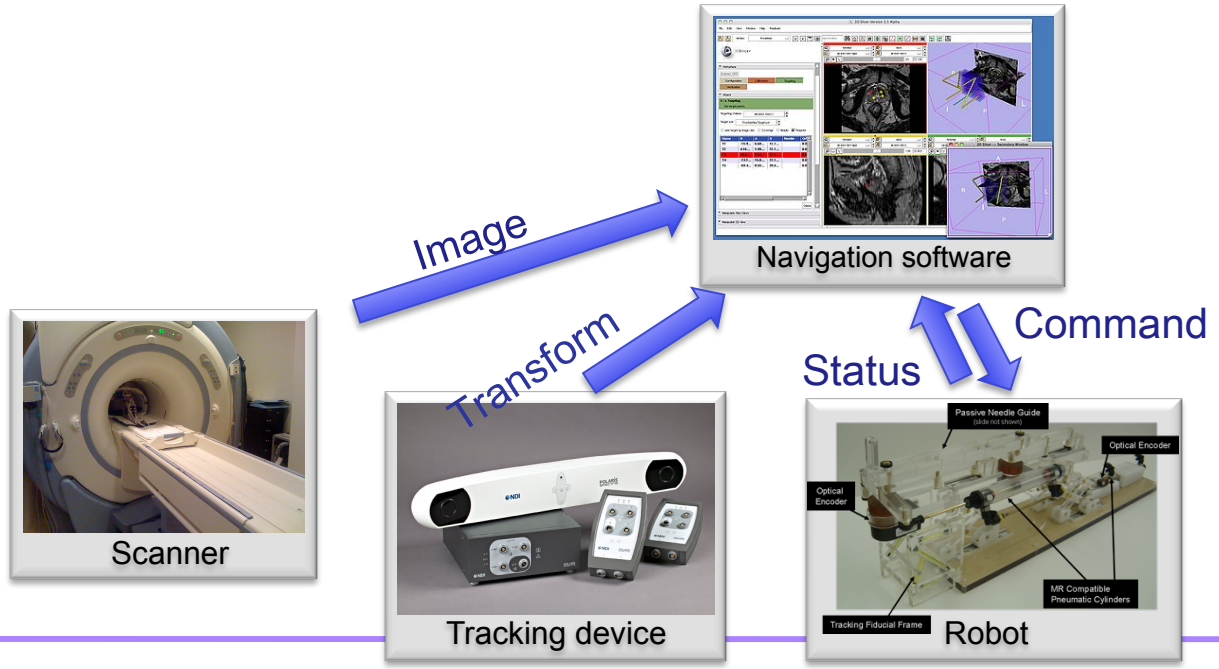


Junichi Tokuda, PhD
Brigham and Women's Hospital
Harvard Medical School

Slicer in Operating Room

3D Slicer's data I/O in OR

- Import images from MRI/CT/Ultrasound..
- Import tool tracking data
- Send commands to robotic devices
- …



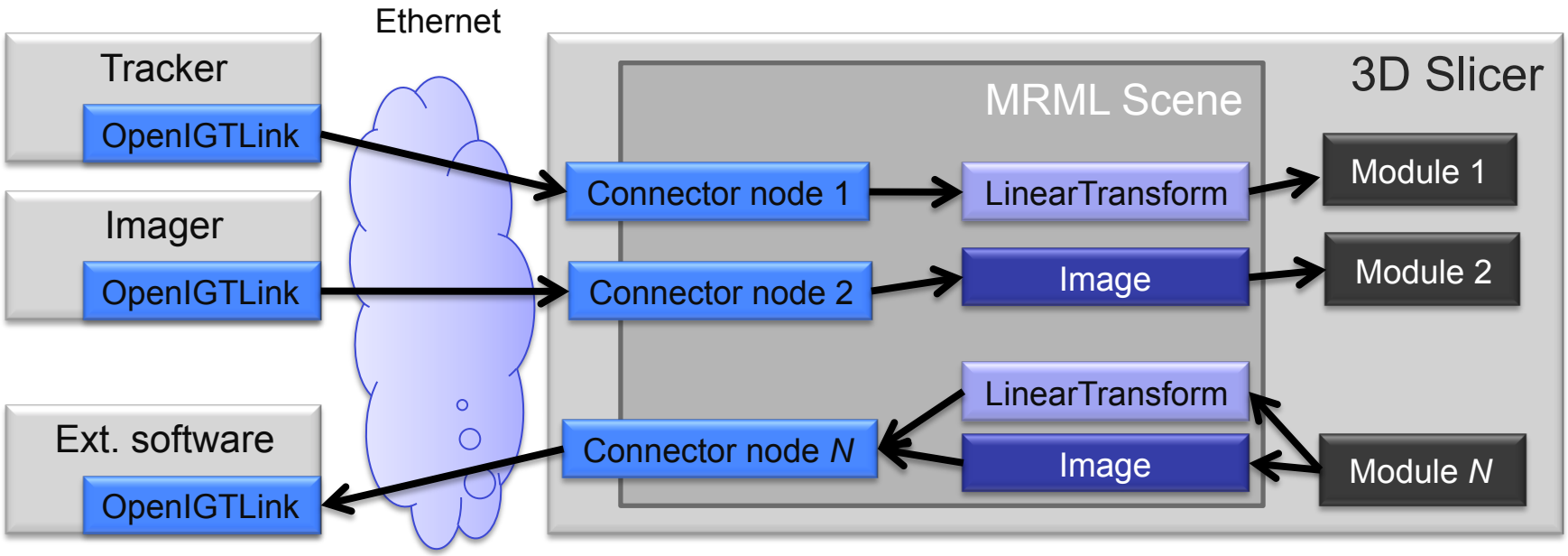
OpenIGTLink

- TCP/IP network communication
  - NDI 3D tracking systems
  - Research software
    - CISST library (JHU), PLUS (Queen's), IGSTK (Kitware), Matlab/Octave, etc

- Why TCP-based network?
  - Available in modern operating rooms
  - Affordable devices (interfaces, switchers and cables)
  - Flexible network topologies
  - Wireless capability (IEEE 802.11a/b/g/n)
  - Reasonable performance (i.e. bandwidth, latency)

3D Slicer OpenIGTLink IF

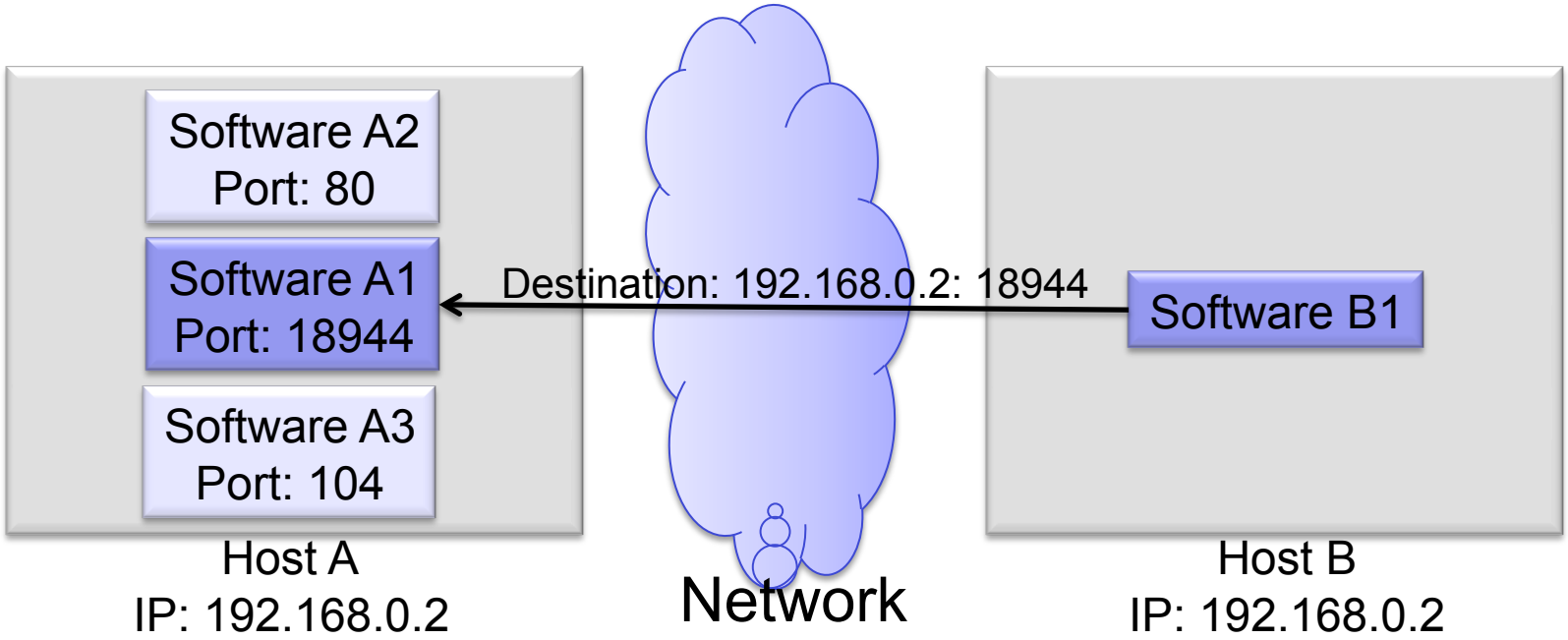
- Import data from remote host MRML scene
- Export data from MRML scene to remote host



TCP Connection Basics (1)

Remote host is specified by

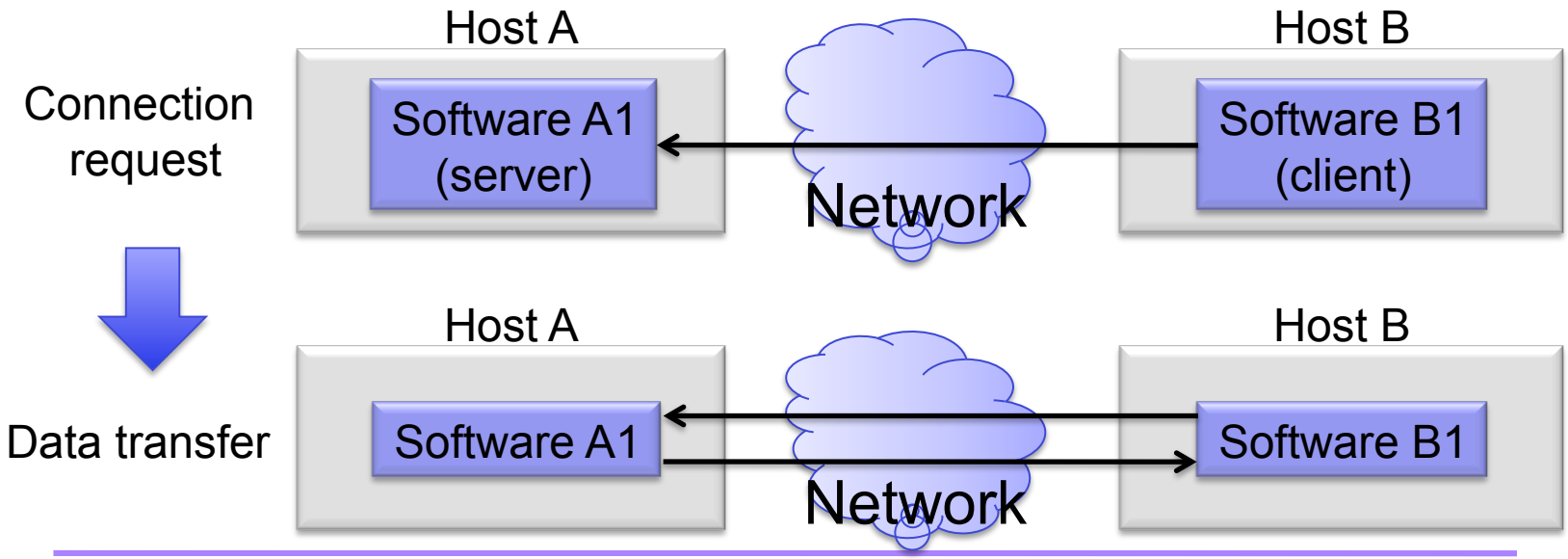
- IP address (i.e. 192.168.0.1) or network address (i.e. watson.bwh.harvard.edu)
- Port number (i.e. 18944)



TCP Connection Basics (2)

"Server" and "Client"

- The server waits for the client at given port.
- The client requests for a connection to the server.
- Server (client) is not necessarily a sender (receiver).
- Slicer can be either server or client



Material

This course requires the following installation:

- 3DSlicer version 4.1 Software (Slicer 4.1.0 r19886), which can be installed from:

http://download.slicer.org/

- Tracker Simulator:

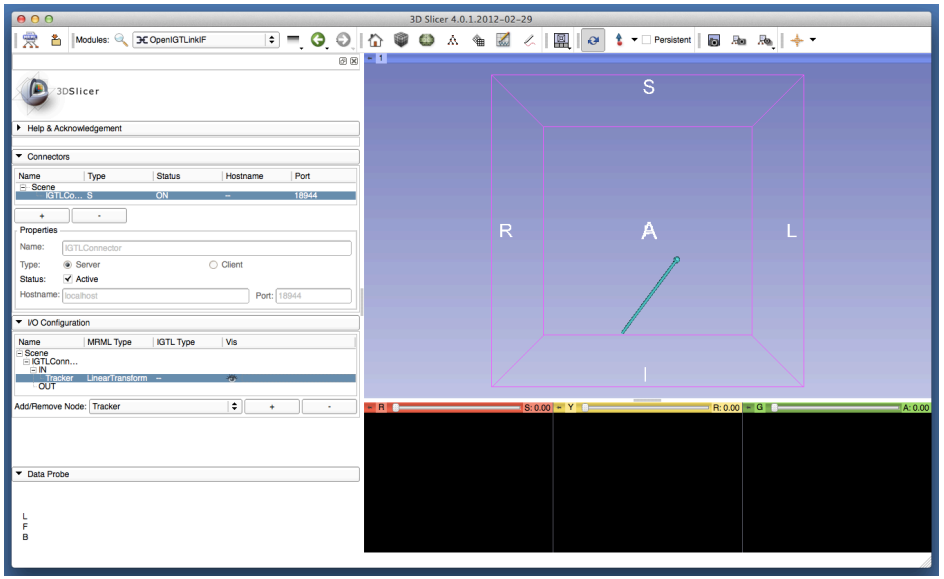
http://wiki.slicer.org/slicerWiki/index.php/Modules:OpenIGTLinkIF-3.6-Simulators

Disclaimer

It is the responsibility of the user of 3DSlicer to comply with both the terms of the license and with the applicable laws, regulations and rules.

Learning objective

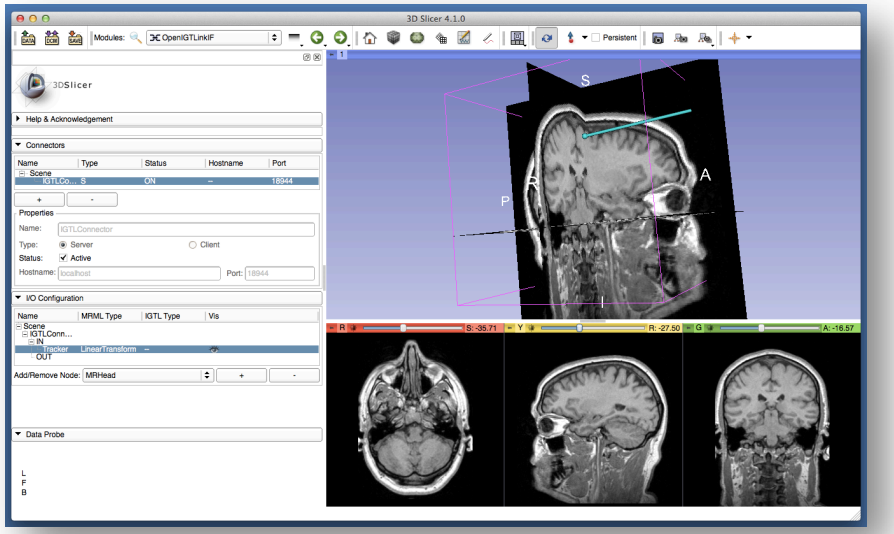
Following this tutorial, you'll be able to import tracking data from external devices (e.g. tracking system) through the network.



3DSlicer

Overview

- Configuring OpenIGTLink IF module
- Setting up Test Server
- Visualizing Tracking Data



Part 1: Configuring OpenIGTLinkIF module

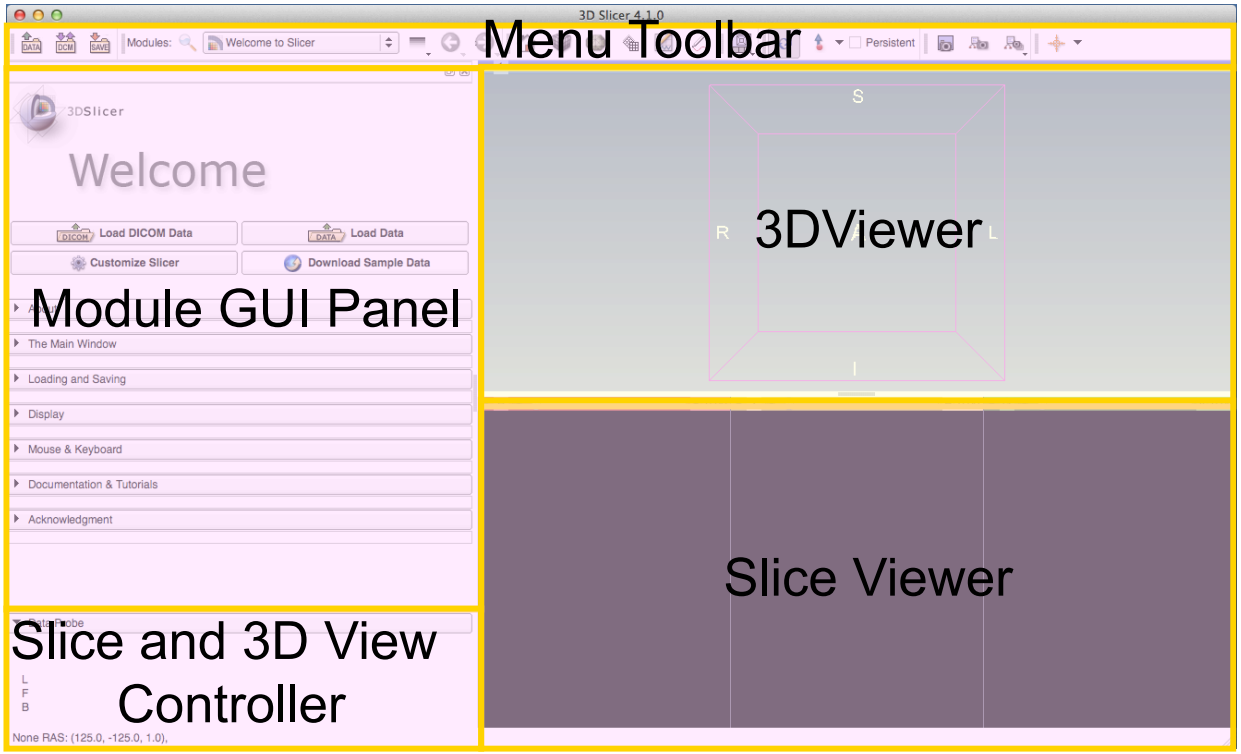
Tokuda, J

National Alliance for Medical Image Computing

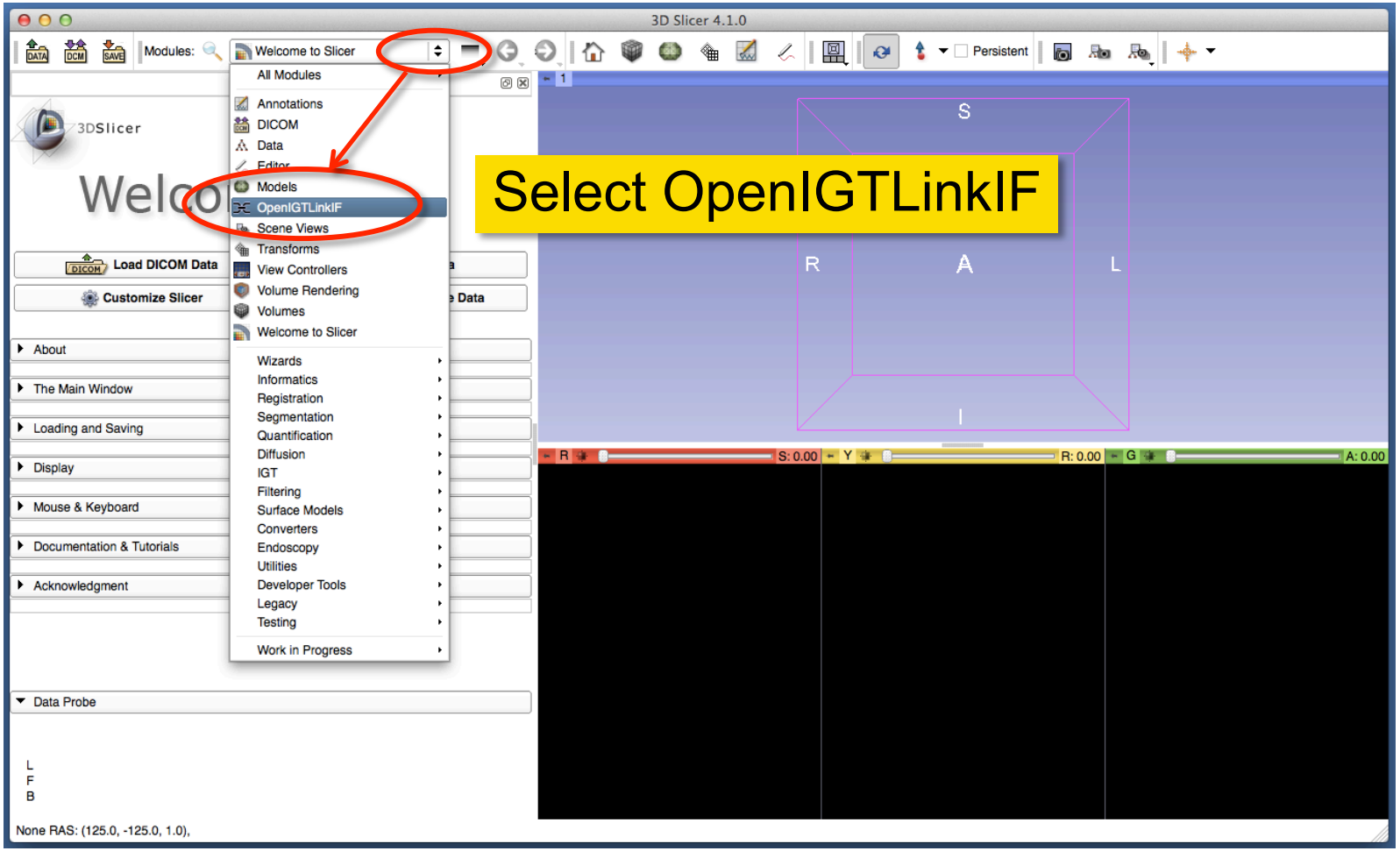
Slicer3 GUI

The Graphical User Interface (GUI) of Slicer3 integrates five components:

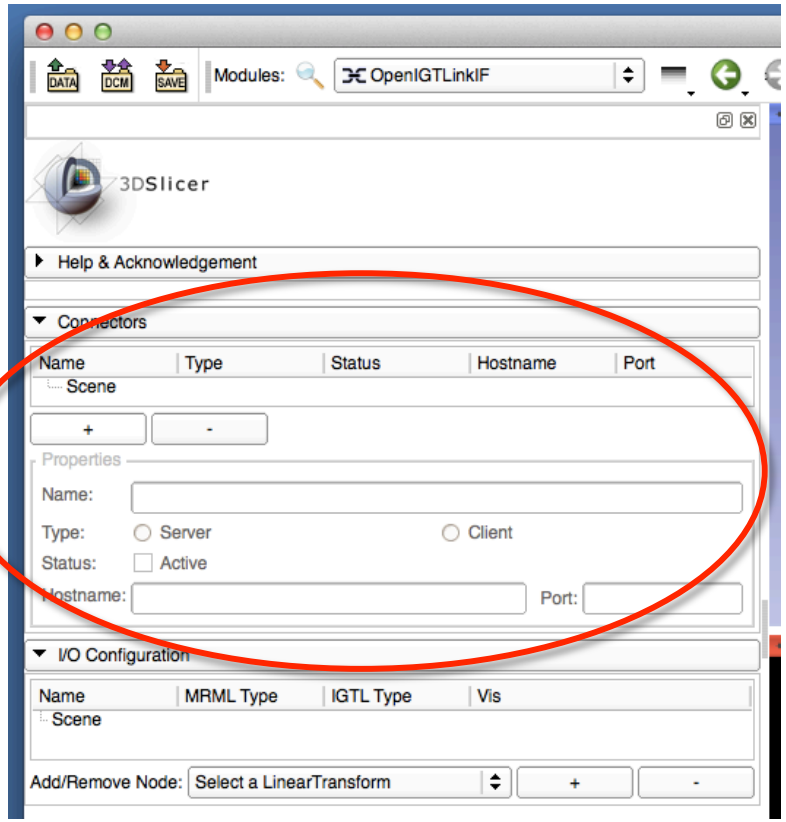
- the Menu Toolbar
- the Module GUI Panel
- the 3D Viewer
- the Slice Viewer
- the Slice and 3D View Controller



Starting OpenIGTLinkIF



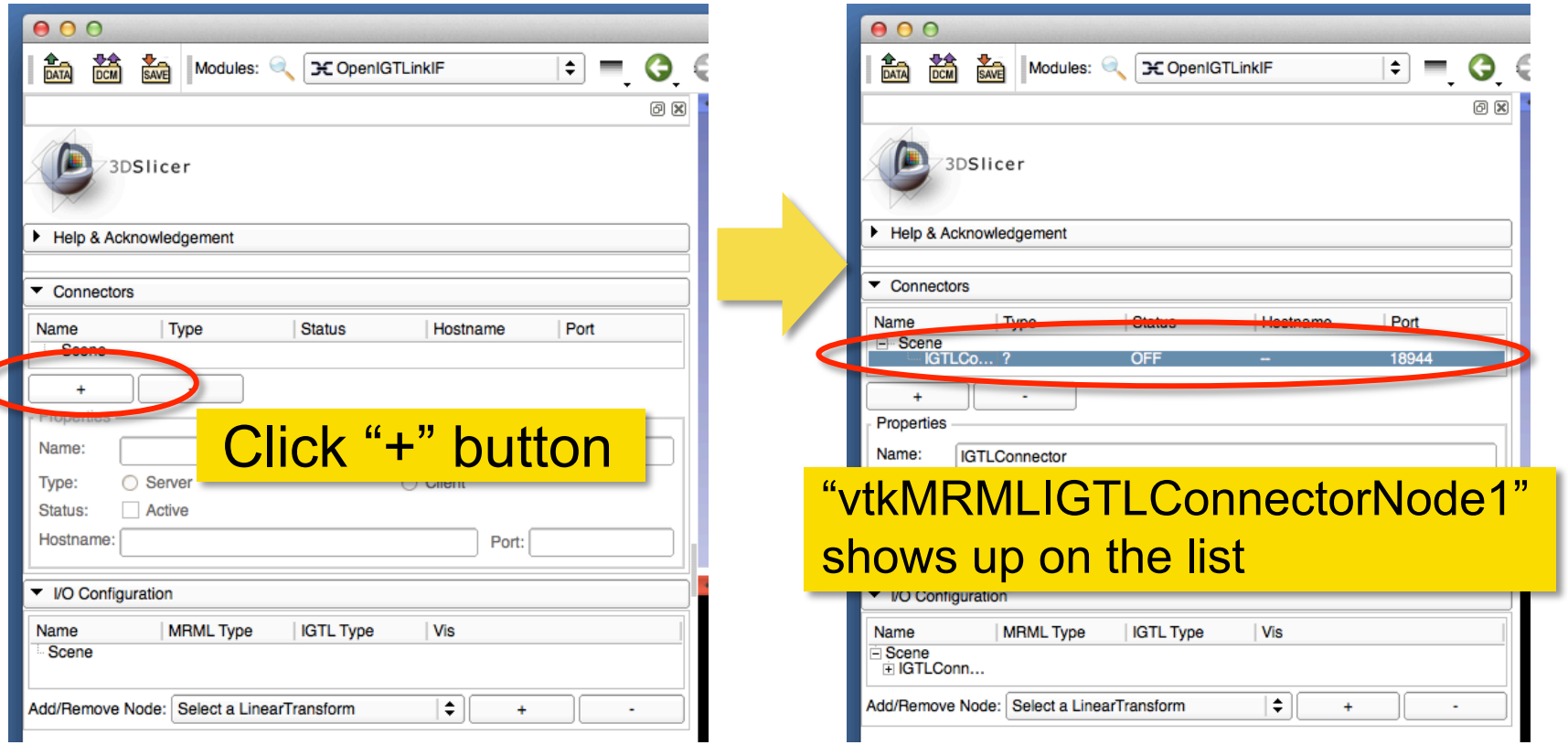
Adding Connector



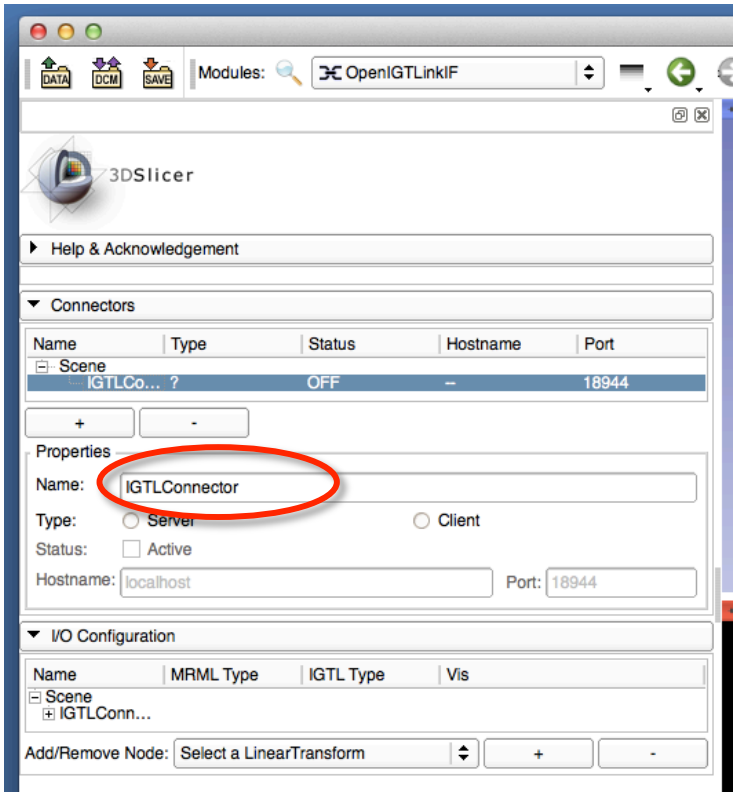
To connect 3D Slicer to external device/software using OpenIGTLink IF, a “connector” has to be created for each connection.

Connectors can be configured in “Connectors” Tab in OpenIGTLink IF module.

Adding Connector



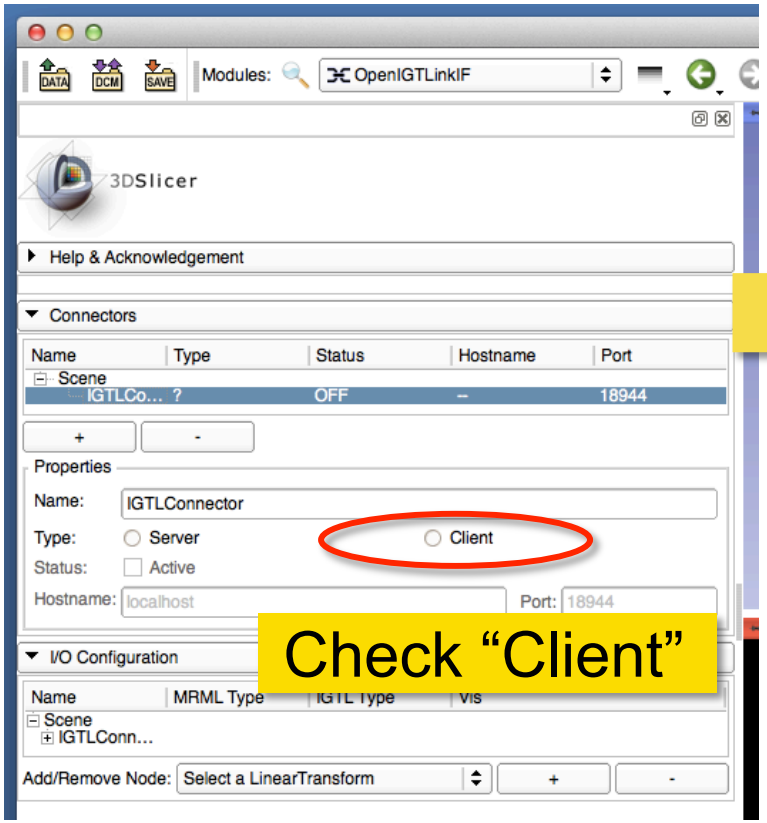
Changing Connector Name

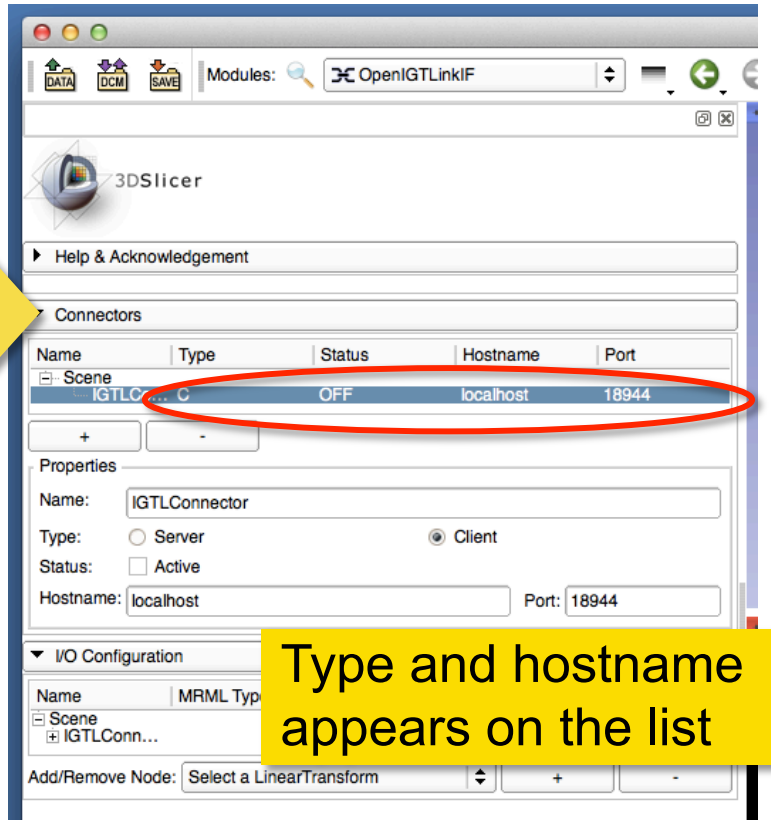


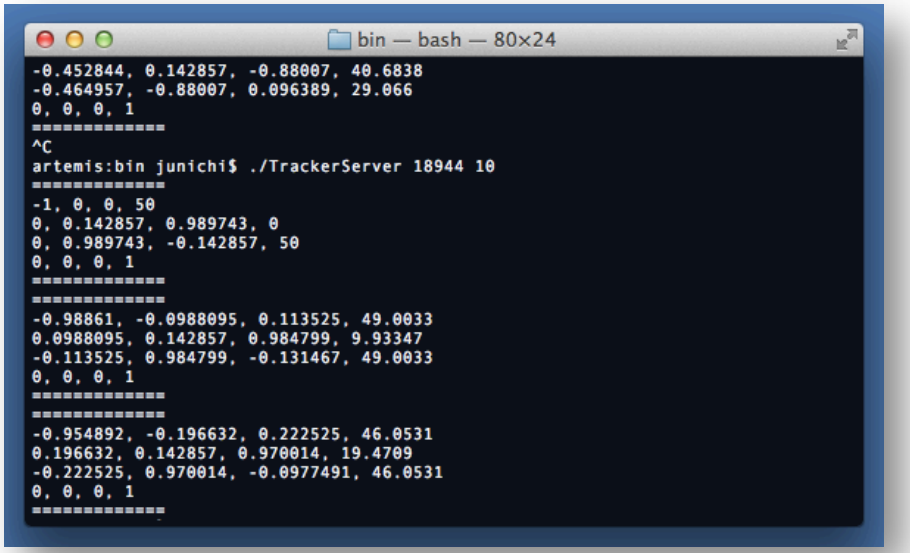
You may change the name of the connector by type in a new name and hit Return key.

This is an optional step. It is a good idea to name connectors, especially if you have multiple connections.

Setting Connector Type

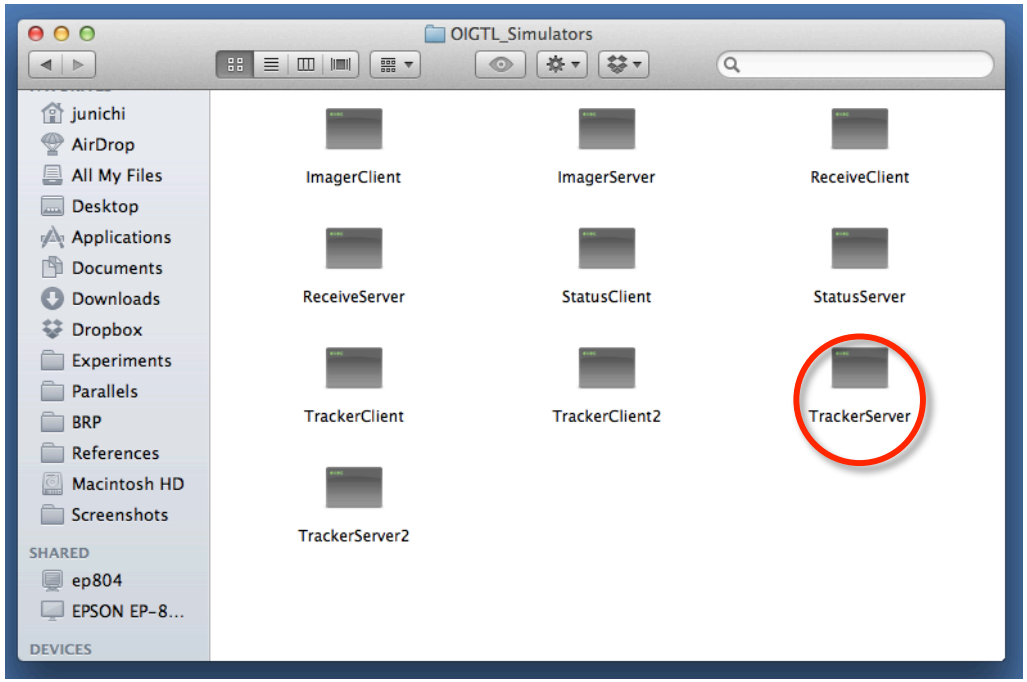






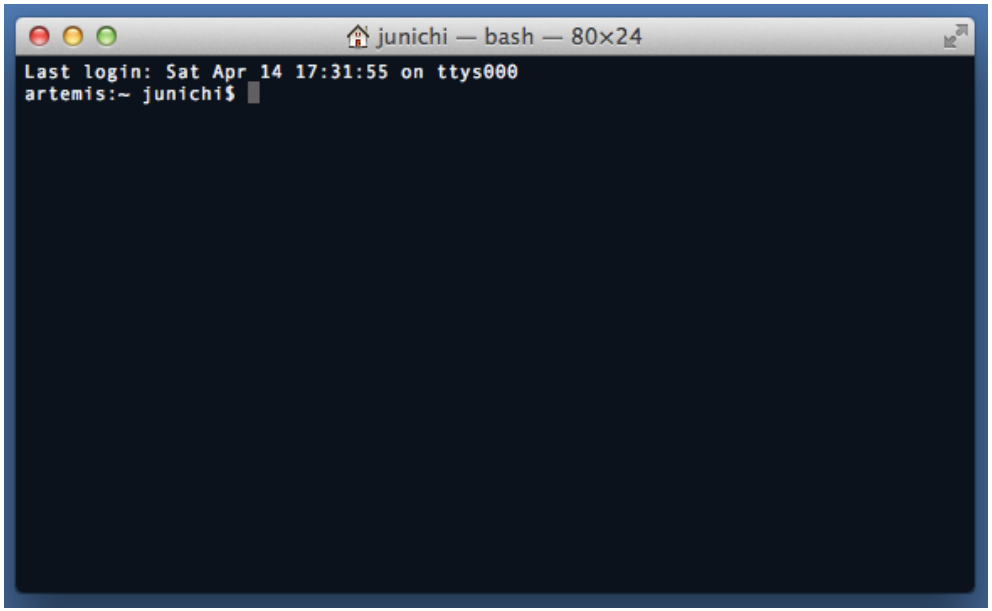
Part 2: Setting up TrackerServer

Extract Server Program



Uncompress the archived simulator files downloaded from the simulator page. Find TrackerServer binary file.

Open Terminal



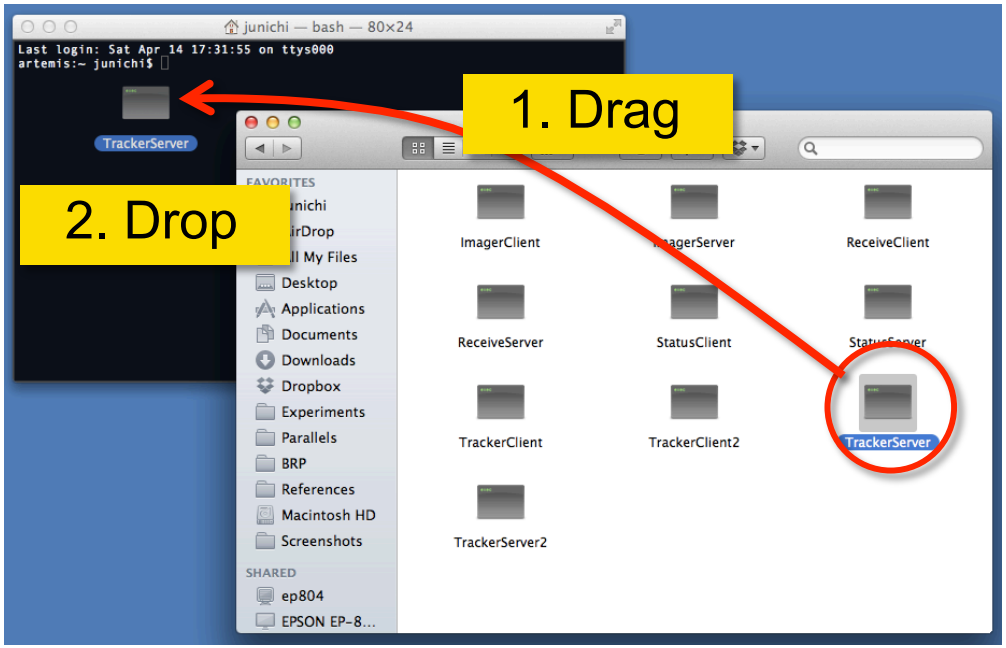
Open a terminal window.

Windows: Open the start menu, type “cmd” in the search box area and then press Enter key.

Mac: Open “Utilities” in “Application” folder and double-click the “Terminal.app” icon.

Linux: Open terminal window.

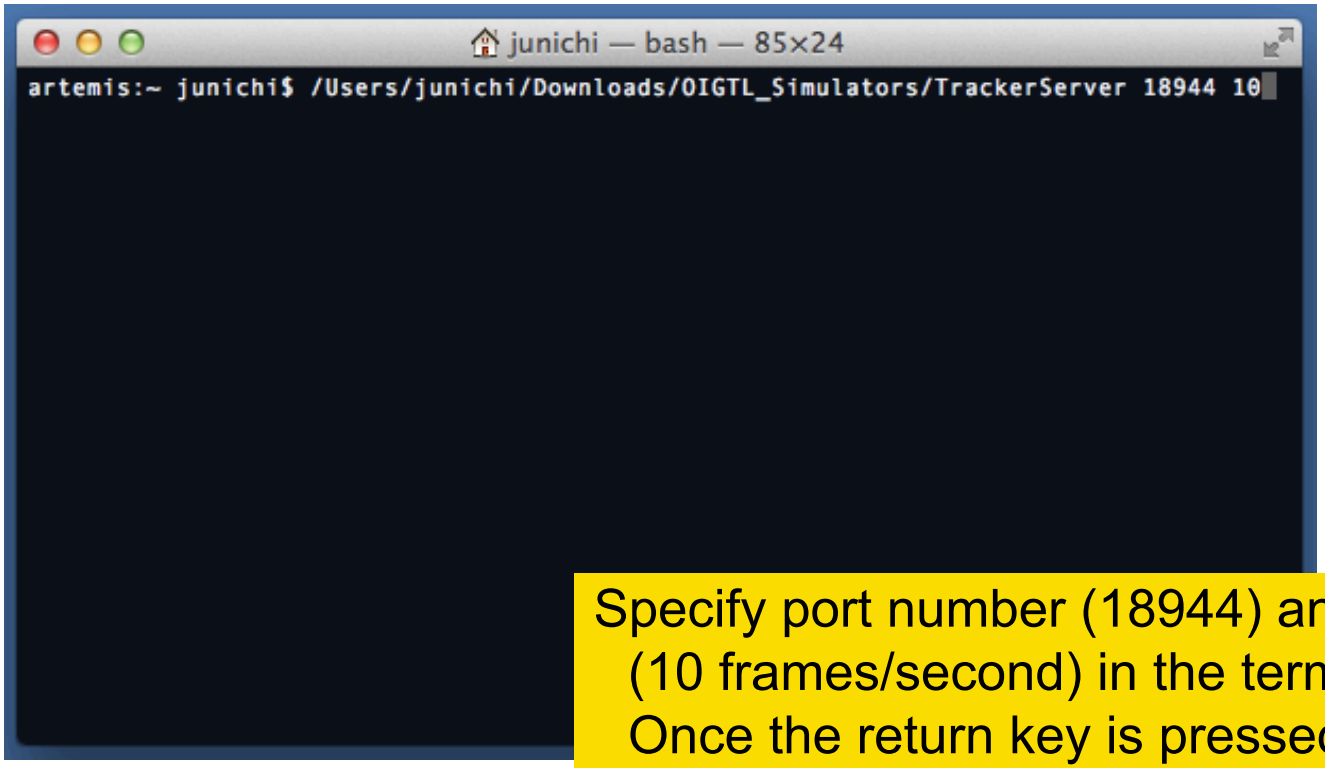
Start TrackerServer (1)



Windows/Mac: Drag "TrackerServer" icon from Explorer (Win) or Finder (Mac) and drop into the command window.

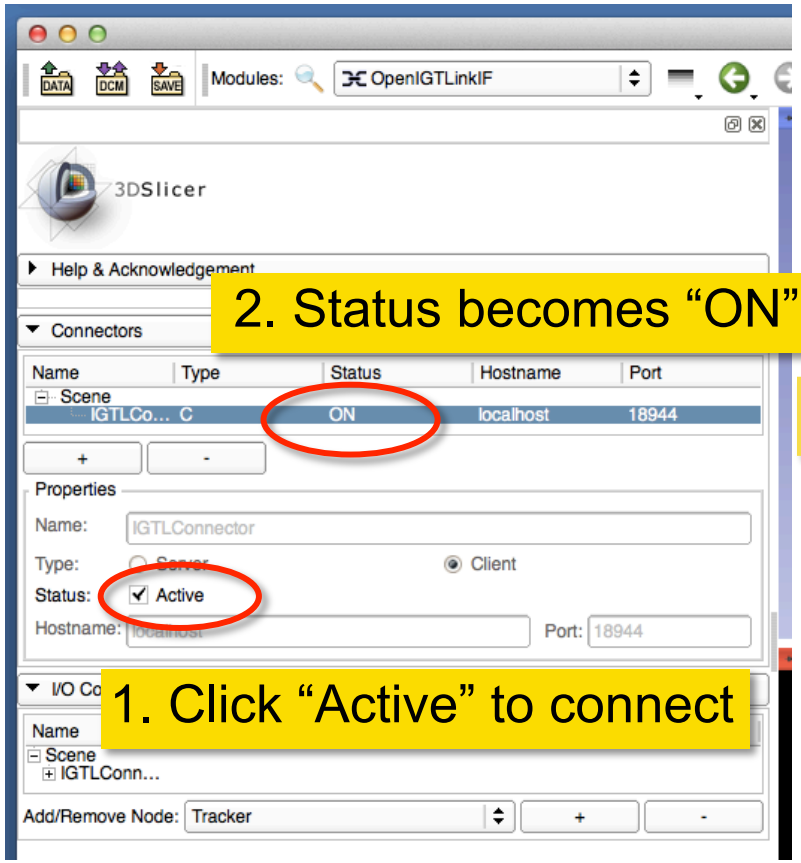
Linux: Type the path to the binary file of "TrackerServer".

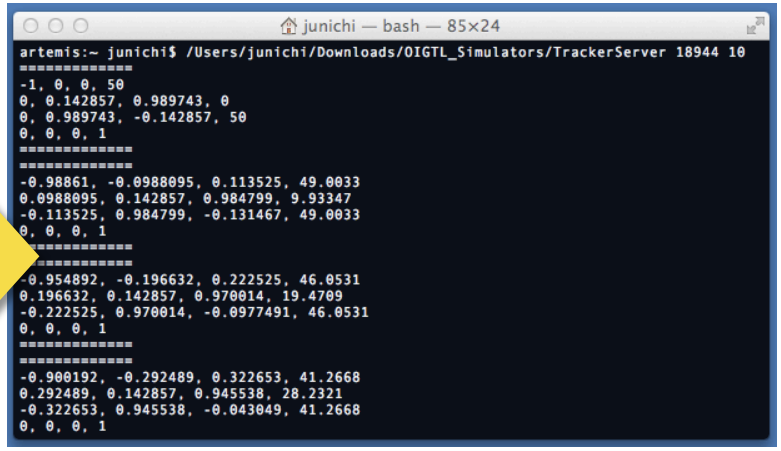
Start TrackerServer (2)



Specify port number (18944) and frame rate (10 frames/second) in the terminal window. Once the return key is pressed, the TrackerServer starts waiting for a client.

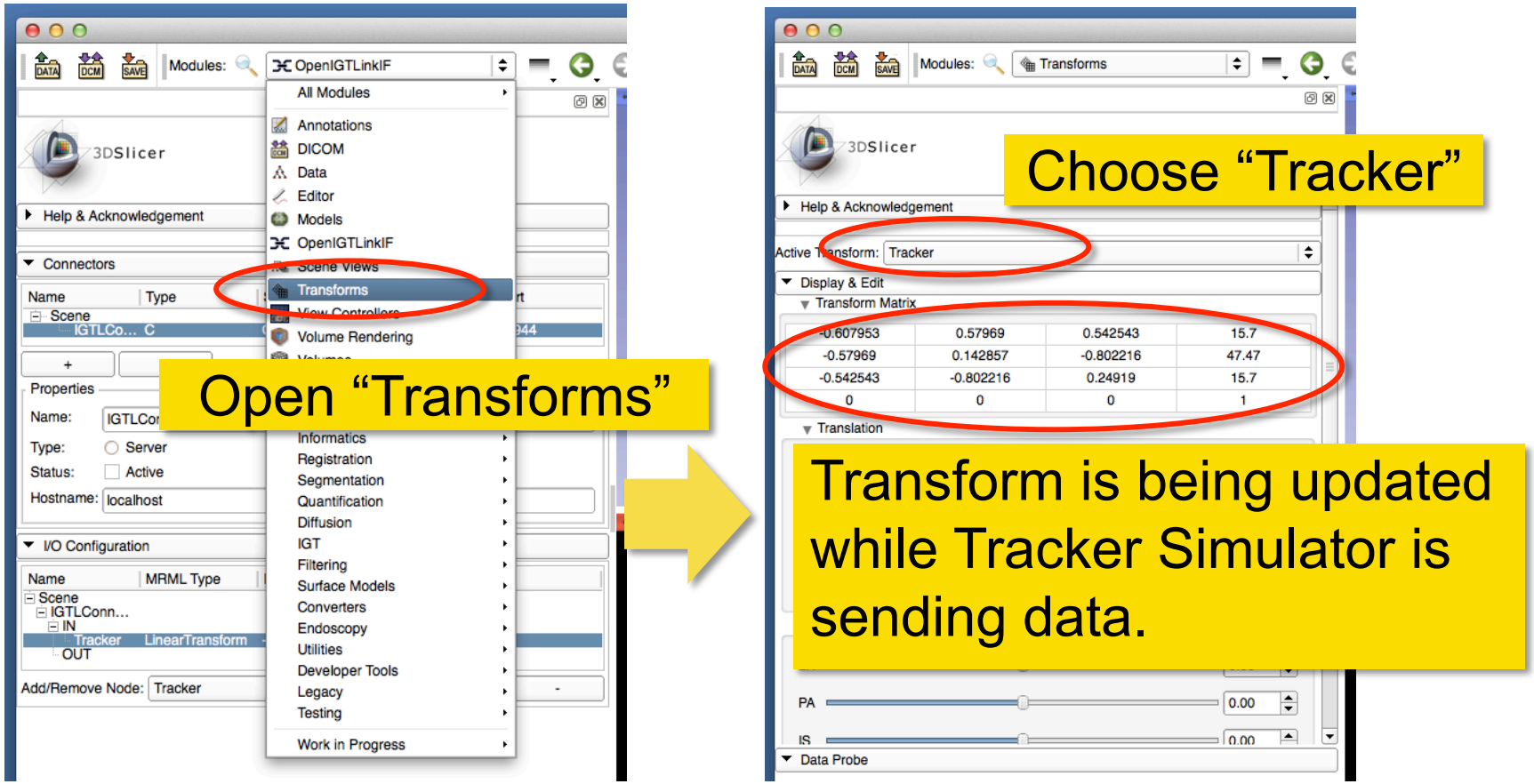
Connect to Test Server

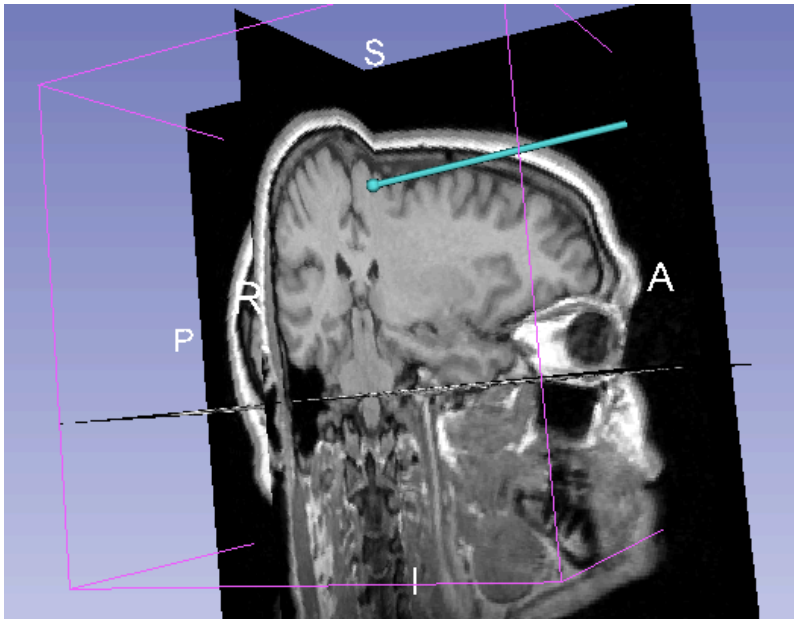




3. Simulator starts printing random transform matrix values in the terminal window.

Checking Transform



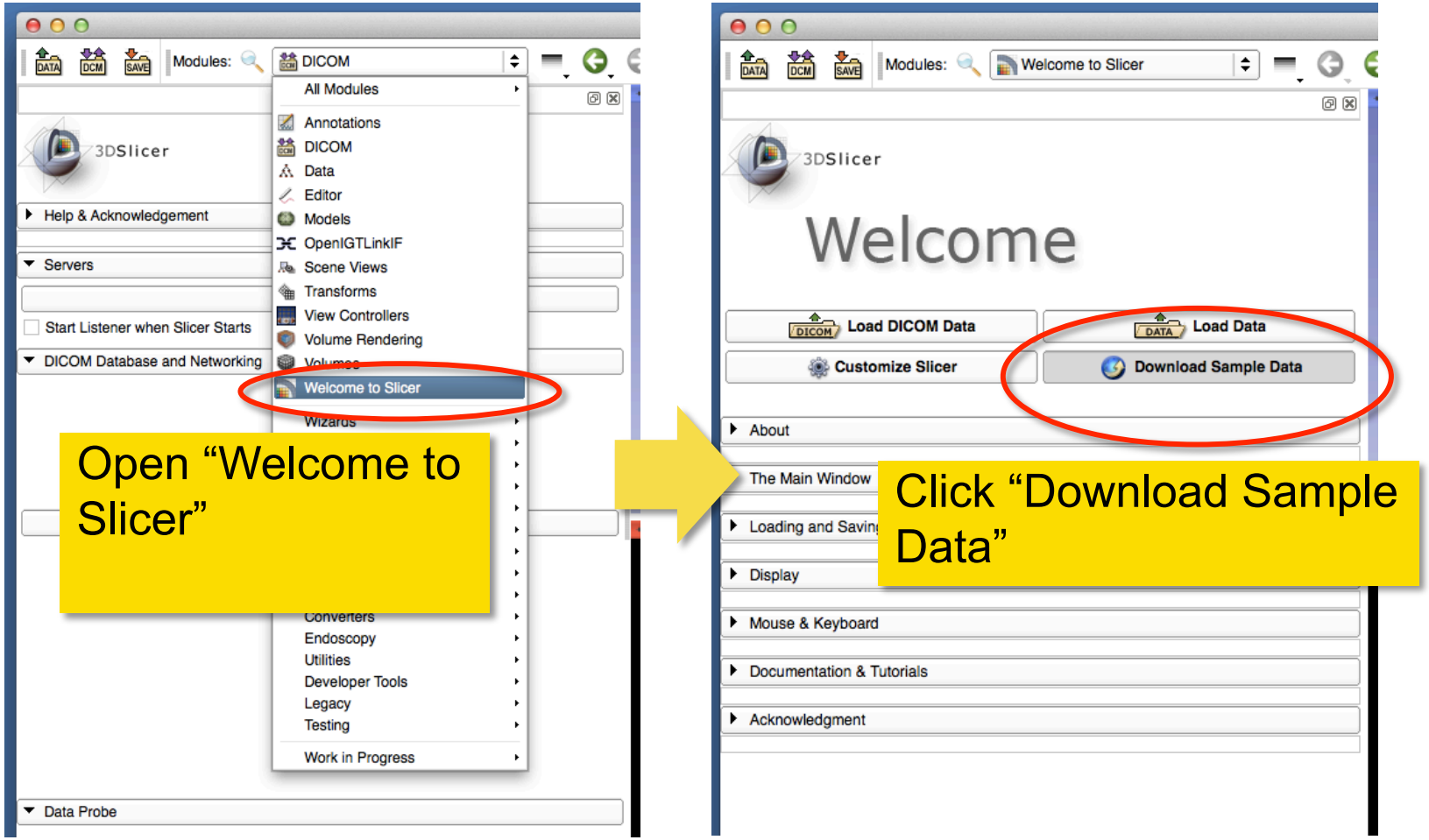


Part 3: Visualizing Tracking Data

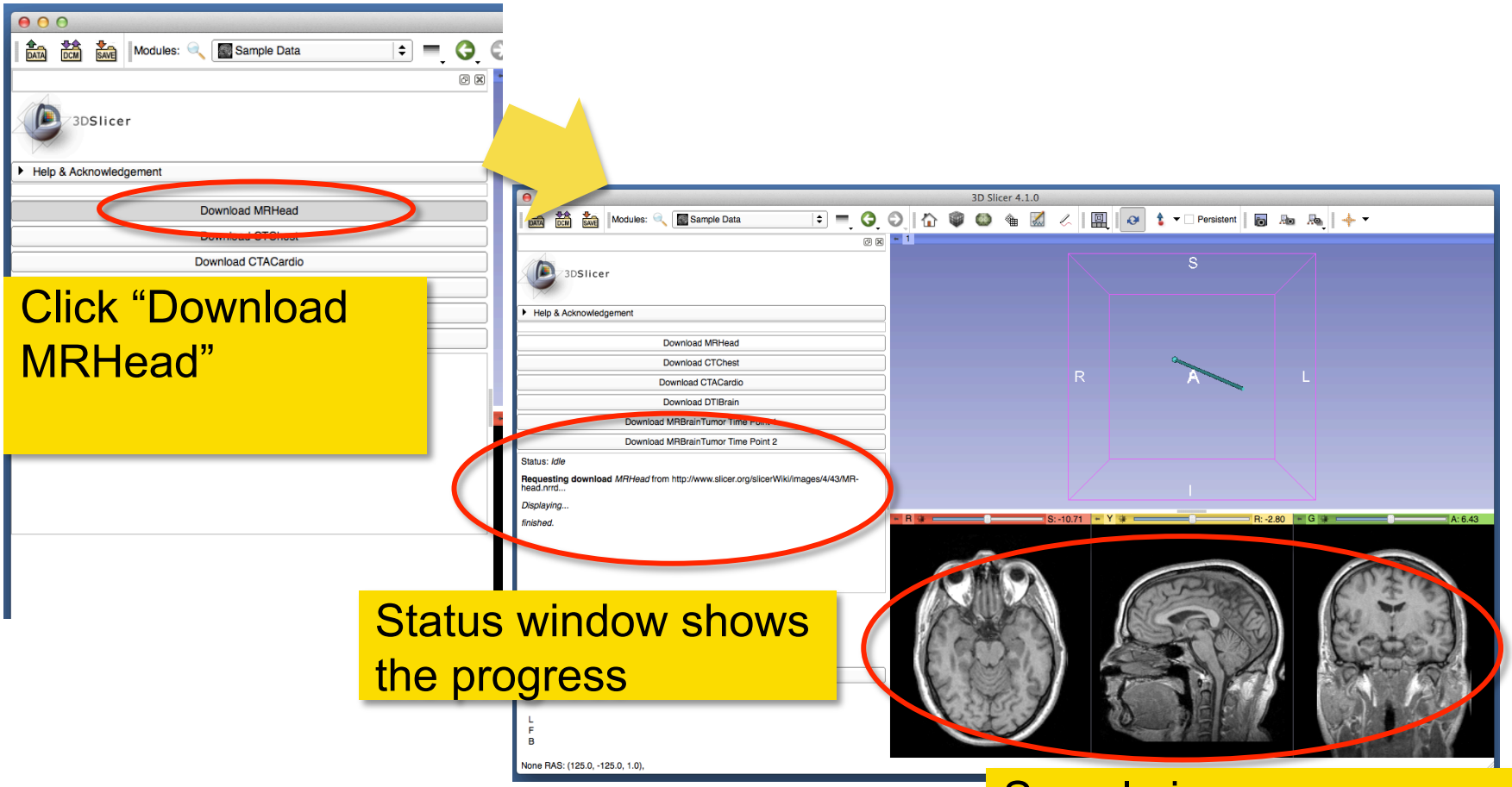
Tokuda, J

National Alliance for Medical Image Computing

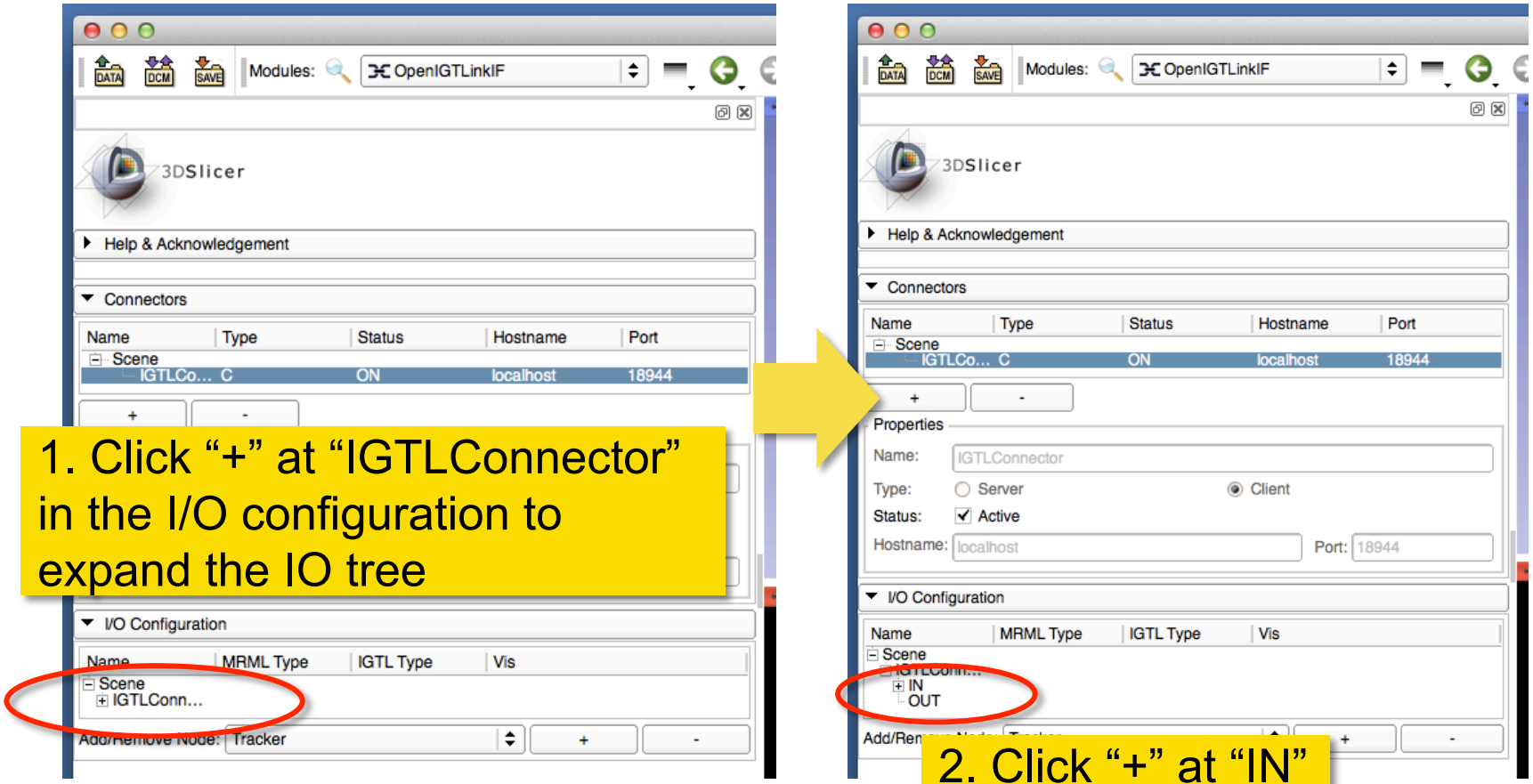
Loading Sample MRI Data



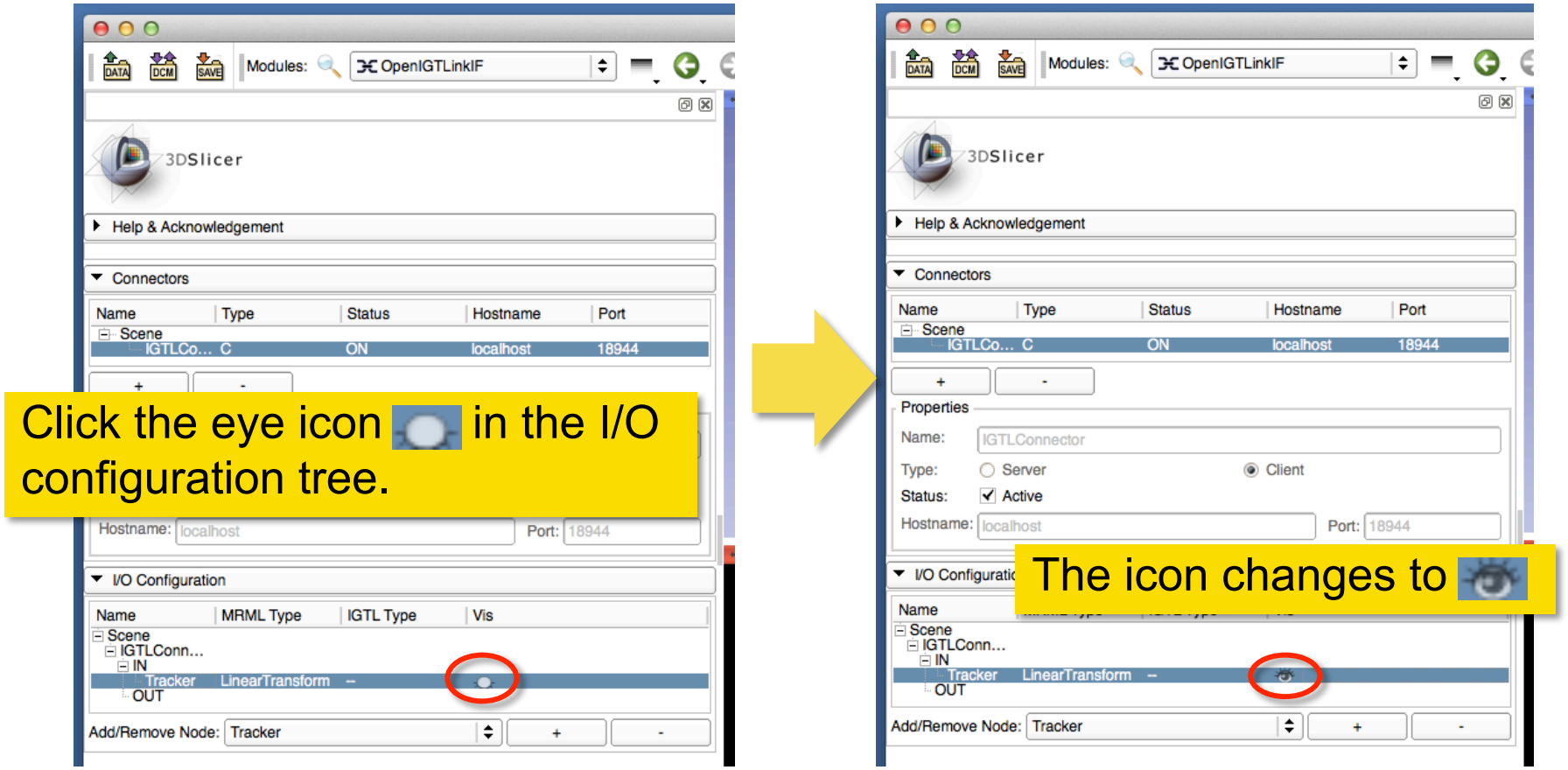
Loading Sample MRI Data



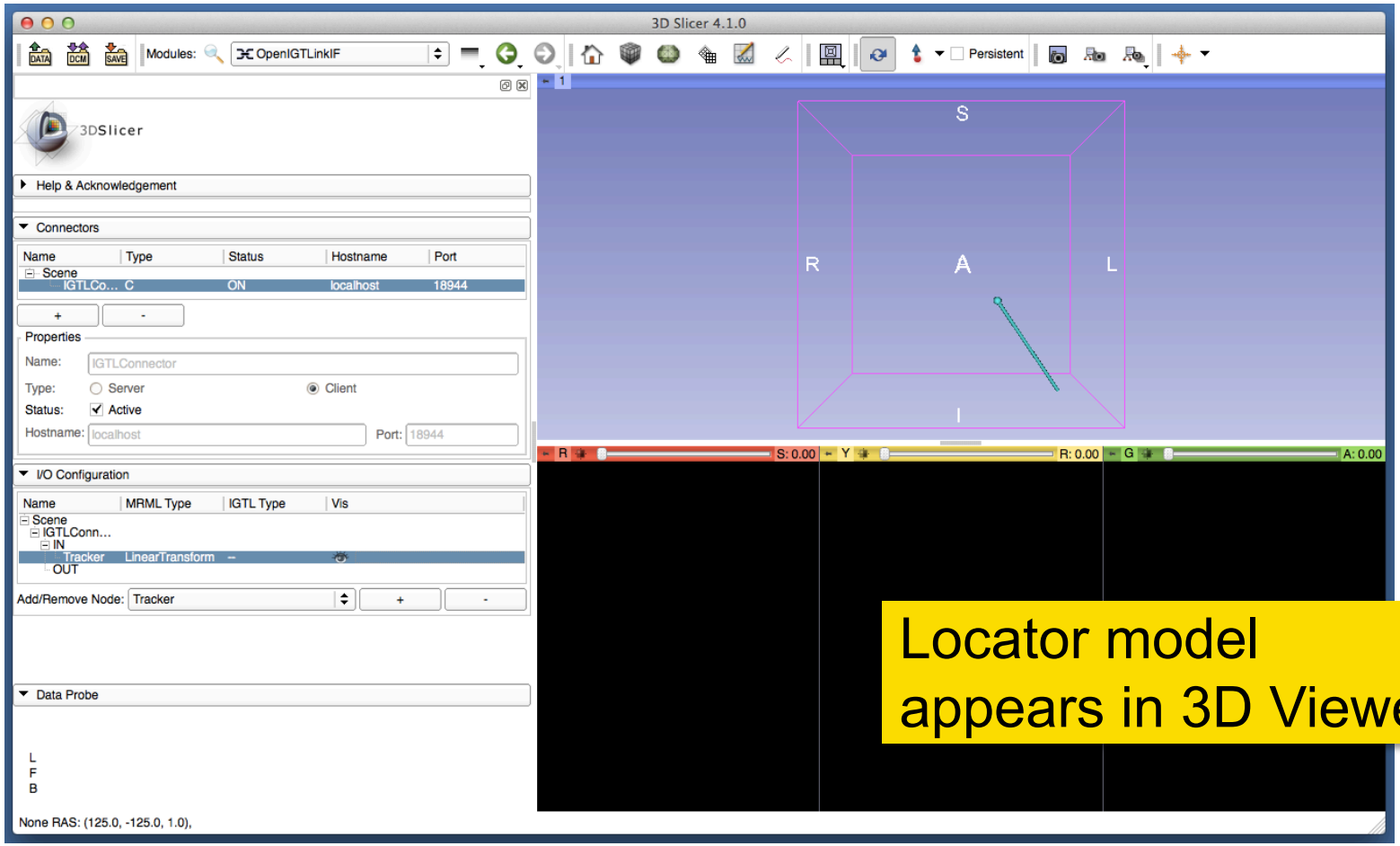
Choosing Locator Source



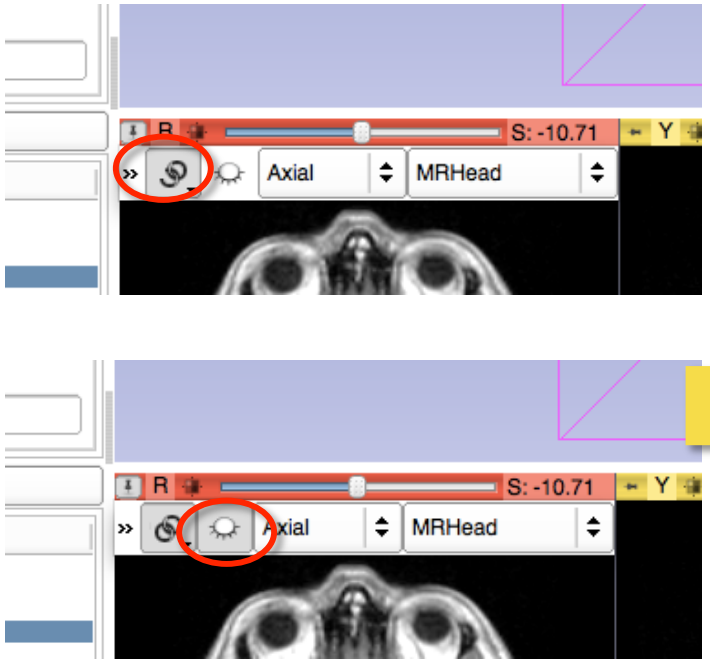
Enable Locator



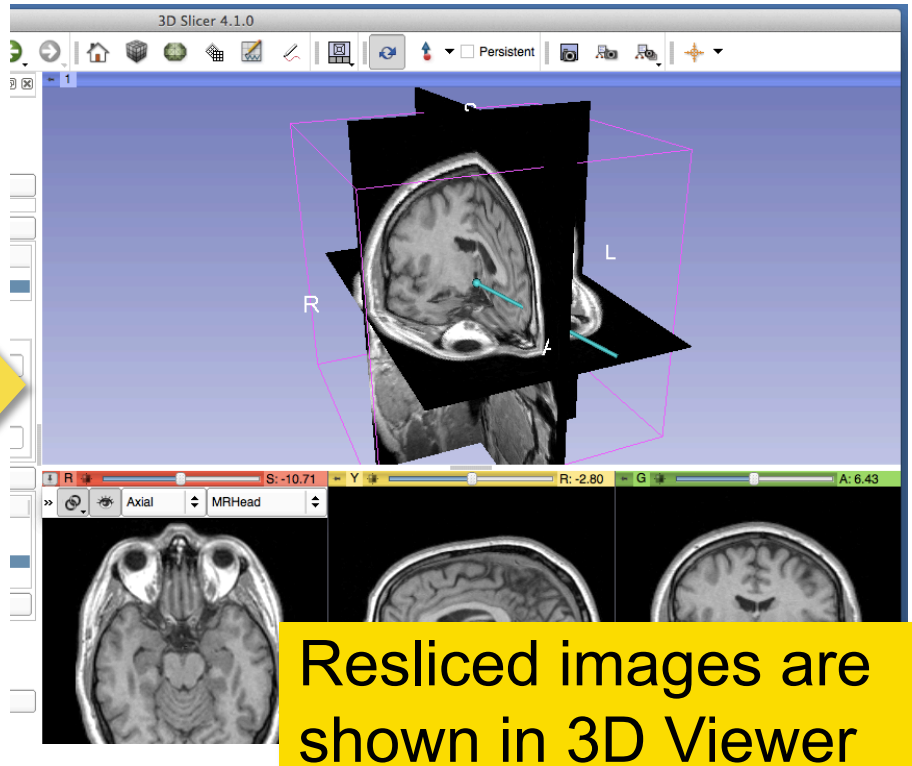
Visualizing Locator



Showing Resliced Images



Click Link button and then Eye button



Resliced images are shown in 3D Viewer

References

- 3D Slicer OpenIGTLinkIF Documentation Page

  http://www.slicer.org/slicerWiki/index.php/Modules:OpenIGTLinkIF-Documentation-4.1

- OpenIGTLink Protocol Web Page:

  http://www.na-mic.org/Wiki/index.php/OpenIGTLink

- Paper

  Tokuda J., *et al.* OpenIGTLink: an open network protocol for image-guided therapy environment. Int J Med Robot. 2009 Dec;5(4):423-34. PMID: 19621334. PMCID: PMC2811069.

Acknowledgments

National Center for Image Guided Therapy (NIH P41RR019703, P41EB015898, P01CA067165, R01CA111288, and R01CA138586)

National Alliance for Medical Image Computing (NIH U54EB005149)

Intelligent Surgical Instruments Project of METI (Japan)