Connecting IGT Device with OpenIGTLink

Junichi Tokuda, PhD
Brigham and Women’s Hospital
Harvard Medical School
3D Slicer’s data I/O in OR

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

Diagram:
- Scanner
- Tracking device
- Robot
- Navigation software
- Image
- Transform
- Status
- Command
OpenIGTLink

- TCP/IP network communication
  - NDI 3D tracking systems
  - Research software
    - PLUS (Queen’s), CISST library (JHU), 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

Diagram:
- Tracker
  - OpenIGTLink
- Imager
  - OpenIGTLink
- Ext. software
  - OpenIGTLink
- Ethernet
- 3D Slicer
- MRML Scene
  - Connector node 1
    - LinearTransform
    - Image
  - Connector node 2
    - LinearTransform
    - Image
  - Connector node N
    - LinearTransform
    - Image
- Module 1
- Module 2
- Module N
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)

![Diagram showing host A and host B with software A1, A2, A3 and software B1 connected through network.](image-url)
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.

Diagram:
- Host A
  - Software A1 (server)
- Host B
  - Software B1 (client)

Connection request and data transfer.
This course requires the following installation:

• 3DSlicer version 4.3.1 Software (Slicer 4.3.1 r22599), 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.
Overview

- Configuring OpenIGTLink IF module
- Setting up Test Server
- Visualizing Tracking Data
Part 1: Installing SlicerIGT module
Open Extension Manager

Select View menu -> Extension Manager
Open Extension Manager

Choose IGT category
Download SlicerIGT Extension

Click “INSTALL” button below SlicerIGT icon

Once the extension has been downloaded, click “Restart” button at the right bottom of the Extension Window
Check Installation

Click Modules menu

Click IGT

If you find Volume Reslice Driver, the installation was successful.
Part 2: Configuring OpenIGTLinkIF module
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

Select 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

Click “+” button

“vtkMRMLIGTLConnectorNode1” shows up on the list
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

Check “Client”

Type and hostname appears on the list
Part 3: 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)

1. Drag
2. Drop

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”.

Last login: Sat Apr 14 17:31:15 on ttys008
$ arcms$ --junichi

TrackerServer
TrackerServer2
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

1. Click “Active” to connect
2. Status becomes “ON”
3. Simulator starts printing random transform matrix values in the terminal window.
Checking Transform

Open “Transforms”

Choose “Tracker”

Transform is being updated while Tracker Simulator is sending data.
Part 4: Visualizing Tracking Data
Loading Sample MRI Data

Open “Welcome to Slicer”

Click “Download Sample Data”
Loading Sample MRI Data

Click “Download MRHead”

Status window shows the progress

Sample image appears in the slice viewer
Choosing Locator Source

1. Click “+” at “IGTLConnector” in the I/O configuration to expand the IO tree

2. Click “+” at “IN”
Enable Locator

Click the eye icon in the I/O configuration tree.

The icon changes to
Locator model appears in 3D Viewer
Open Volume Reslice Driver

Click Modules menu

Click IGT

Click Volume Reslice Driver
Choose Driver Transform

Click Driver menu -> select Tracker in the Red Slice frame
Choose Driver Transform

Click Eye icon to show the slice in 3D viewer

The axial slice appears in 3D viewer
Activate Reslicing

Click Mode menu -> select “Inplane” in the Red slice frame

The slice starts following the locator
Activate Reslicing for Other Planes

In the Yellow slice frame, select Tracker from the Driver menu

Select Inplane 90 from the Mode menu

In the Green slice frame, select Tracker from the Driver menu

Select Transverse from the Mode menu
Activate Reslicing for Other Planes

The 3 orthogonal planes follow the locator.
References

• 3D Slicer OpenIGTLinkIF Documentation Page
  

• OpenIGTLink Protocol Web Page:
  
  http://www.na-mic.org/Wiki/index.php/OpenIGTLink

• Paper
  
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