

3D-Slicer Visualization Documentation

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The following is documentation regarding the implementation of the 3D-slicer visualization system. Much of the following information can be obtained from the websites for the Slicer project, OpenIGTLink, and PLUS Toolkit.

Necessary Installations

Installing 3D-Slicer

Slicer can be downloaded from slicer.org. For the purposes of this application, a particular version is not necessary.

Installing Required Slicer Extensions

Once slicer is installed, it is perimount that the following extensions be installed.

1. OpenIGTLink – This will be used to receive information from the PLUS Toolkit Server.
2. SlicerIGT – This includes the necessary elements for PLUS Toolkit.
3. SlicerIGTIO - This includes to other necessary elements for PLUS Toolkit.

Extensions can be installed, through Slicer's extensions manager. It can be found on the righthand side of the toolbar

Installing PLUS

PLUS can be installed from the following website: plustoolkit.github.io. Be sure to install the Win64 version, as this version is best able to communicate with NDI Polaris.

Implementation

Once Slicer is launched, a DICOM can be loaded in by clicking on the DICOM browser icon on the left-hand side of the toolbar. The implant can be loaded using the DATA browser that can be accessed in the same region.

Getting Oriented

Slicer consists of a visualization on the left with several slice views as well as a module interaction window on the write. What is seen in this window can be access through the module search bar.

Volume Rendering

To see your DICOM in the visualization window, search for the Volume Rendering module. Once there, select your DICOM and select the CT-Bone preset. You will still not see anything until you click on the eye icons to the left of the module next to Volume and the caption Display ROI.

OpenIGTLink

Next navigate to the OpenIGTLink module. Click on the plus sign below connectors to add a connector. Under properties select Client and Active. Go to the I/O section of the page and select te drop down

menu of the connector you just created. Select IN. Slicer is now ready to receive information from a server.

PLUS Toolkit

Open up the folder in which PLUS Toolkit is installed. In the bin folder you will find the PLUS Server Launcher. Once this has launched, it will ask for a device configuration file. This must be created specific for your tracking system. Information regarding this can be seen on PLUS Toolkit's user manual webpage, a link to which is included below. One device set configuration file we developed is given in the appendix. You can place your specific device set configuration file in the config folder of the Plus-App directory (where it is installed). After this is done, select it in the PLUS Server Launcher in the corresponding drop-down menus.

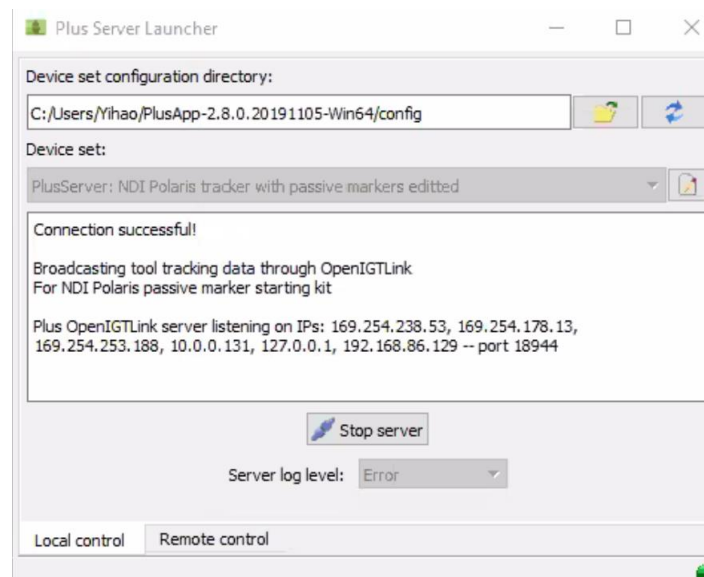


Figure 1: Plus Server Launcher Menu

Once the correct device set is select, you can launch the server. The window should like the image above and state that connection is successful.

Visualize Tracking

Once connection is established, navigate to the data module in Slicer. You should see the transforms you defined in your device set configuration file. You can check the OpenIGTLink module to ensure that data is coming in. If not, check the Plus Remote module and select your correct server, this step may not be necessary.

Navigate to the Transforms module, here you should see a continually updated transform matrix appear corresponding to your tracking data. If scroll further down, you should see a drop-down menu titled Apply Transform. Here you can select a model of your tracker and the implant. They will now move with the corresponding tracker data.

Additionally, Slicer has the capability to create tracker models if you would like to use them. They can be created in the CreateModels module.

Useful Links

This links have comprehensive information about using Slicer in conjunction with PLUS Toolkit and OpenIGTLink, along with tutorials and examples.

3D-Slicer:

<https://www.slicer.org/>

PLUS Toolkit:

<https://plustoolkit.github.io/>

OpenIGTLink:

<http://openigtlink.org/>

OpenIGTLink Setup:

https://www.slicer.org/w/img_auth.php/f/f1/OpenIGTLinkTutorial_Slicer4.1.0_JunichiTokuda_Apr2012.pdf

PLUS Toolkit User Manual:

<http://perk-software.cs.queensu.ca/plus/doc/nightly/user/Configuration.html>

Citations

Tokuda, J., Fischer, G. S., Papademetris, X., Yaniv, Z., Ibanez, L., Cheng, P., Liu, H., Blevins, J., Arata, J., Golby, A. J., Kapur, T., Pieper, S., Burdette, E. C., Fichtinger, G., Tempany, C. M., & Hata, N. (2009). OpenIGTLink: an open network protocol for image-guided therapy environment. *The international journal of medical robotics + computer assisted surgery* : MRCAS, 5(4), 423–434.

<https://doi.org/10.1002/rcs.274>

Andras Lasso, Tamas Heffter, Adam Rankin, Csaba Pinter, Tamas Ungi, and Gabor Fichtinger, "PLUS: Open-source toolkit for ultrasound-guided intervention systems", *IEEE Trans Biomed Eng.* 2014 Oct;61(10):2527-37. doi: 10.1109/TBME.2014.2322864

Appendix (Device Set Configuration File)

```
<PlusConfiguration version="2.1">

  <DataCollection StartupDelaySec="1.0" >
    <DeviceSet
      Name="PlusServer: NDI Polaris tracker with passive markers edited"
      Description="Broadcasting tool tracking data through OpenIGTLink
For NDI Polaris passive marker starting kit" />
    <Device
      Id="TrackerDevice"
      Type="PolarisTracker"
      ToolReferenceFrame="Tracker" >
      <DataSources>
        <DataSource Type="Tool" Id="Tool1" RomFile="NdiToolDefinitions/CarbonFiberFiducial.rom" />
        <DataSource Type="Tool" Id="Stylus" RomFile="NdiToolDefinitions/SD.960-553.rom" />
      </DataSources>
      <OutputChannels>
        <OutputChannel Id="TrackerStream" >
          <DataSource Id="Tool1"/>
          <DataSource Id="Stylus"/>
        </OutputChannel>
      </OutputChannels>
    </Device>
  </DataCollection>

  <!-- <CoordinateDefinitions>
    <Transform From="StylusTip" To="Stylus"
      Matrix="
        1 0 0.000203823 0.0180449
        3.31529e-09 -1 -1.62655e-05 -0.00144002
        0.000203823 1.62655e-05 -1 -88.5321
        0 0 0 1"
      Error="0.554951" Date="012617_105449" />
  </CoordinateDefinitions> -->

  <PlusOpenIGTLinkServer
    MaxNumberOfIgtlMessagesToSend="10"
    MaxTimeSpentWithProcessingMs="50"
    ListeningPort="18944"
    SendValidTransformsOnly="true"
    MissingInputGracePeriodSec="5.0"
    SendColumnMajorTransforms = "false"
    OutputChannelId="TrackerStream" >
    <DefaultClientInfo>
      <MessageTypes>
        <Message Type="TRANSFORM" />
      </MessageTypes>
  </PlusOpenIGTLinkServer>
```

```
<TransformNames>  
  <Transform Name="Tool1ToStylus" />  
</TransformNames>  
</DefaultClientInfo>  
</PlusOpenIGTLinkServer>  
  
</PlusConfiguration>
```