ECOG ELECTRODES VISUALIZATION TUTORIAL

To visualize electrodes on a brain cortex we need MRI preimplantation and CT post-implantation scans series. For cortical surface extraction we have to use T1 MRI scan that contain no less than 160 slices. First of all we have to extract T1 scan series from data obtained from clinicians. This can be done with medical images viewer, for example, OsiriX for macOS platform or RadiAnt for Windows platform.

Cortical surface extraction can be carried out using FreeSurfer software. After FreeSurfer installation according recommendations from official website run the following command in a terminal:

recon-all -i folder_containing_MRI_T1_scan_series/IM-0001-0001.dcm -s subject_name -all

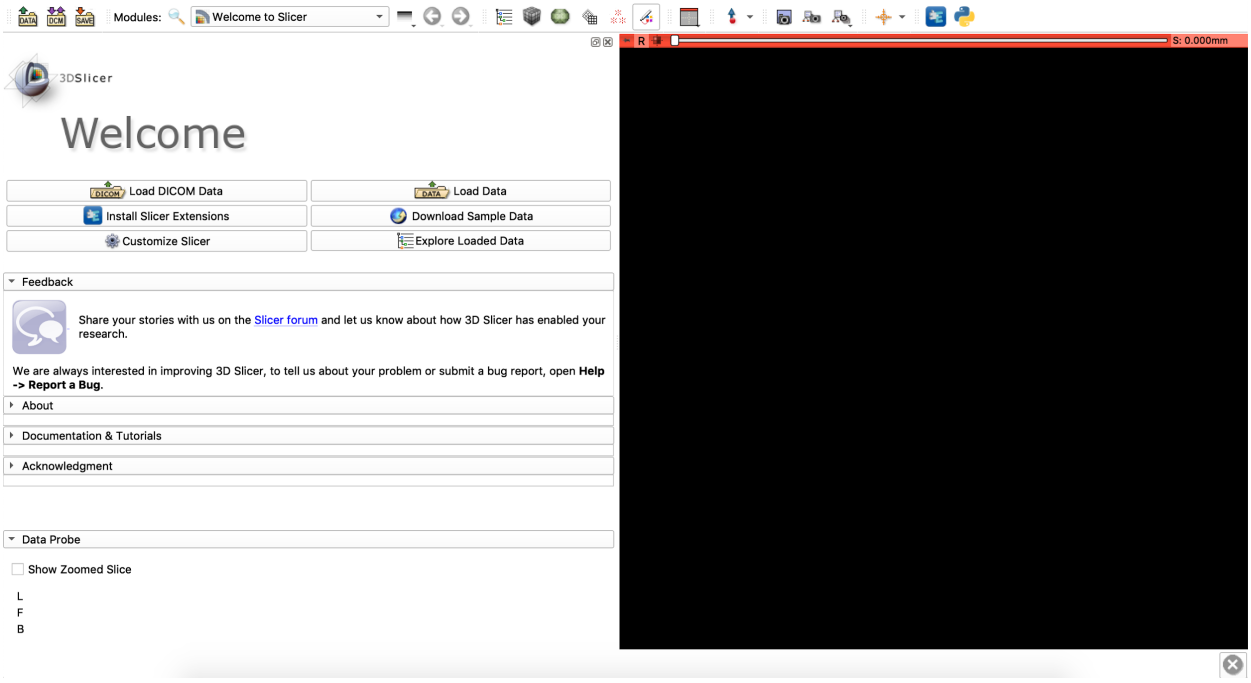
This command will run the full FreeSurfer processing pipeline.

folder_containing_MRI_T1_scan_series/IM-0001-0001.dcm has to be the path to one *.dcm file in the directory, FreeSurfer will figure out the rest.

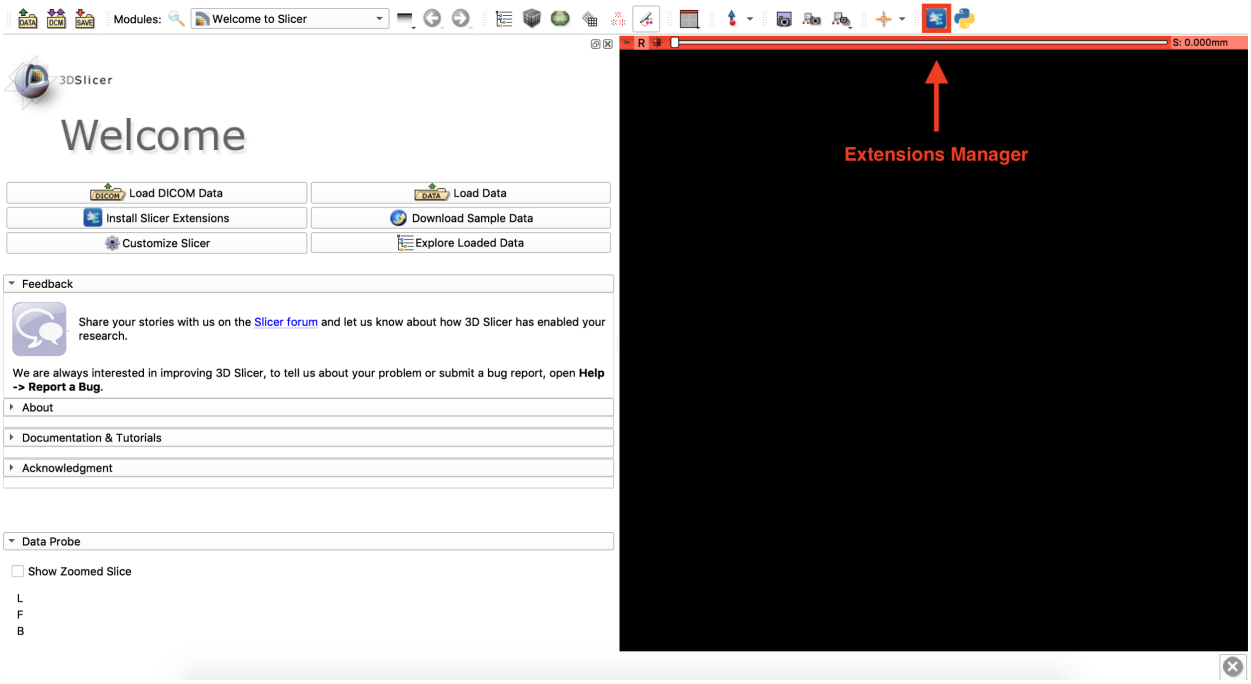
subject_name has to be the name of the output directory that will be created by FreeSurfer.

Resulting surfaces can be found under **freesurfer/subjects/subject_name/surf**: lh.pial and rh.pial are left and right halves of cortical surface respectively.

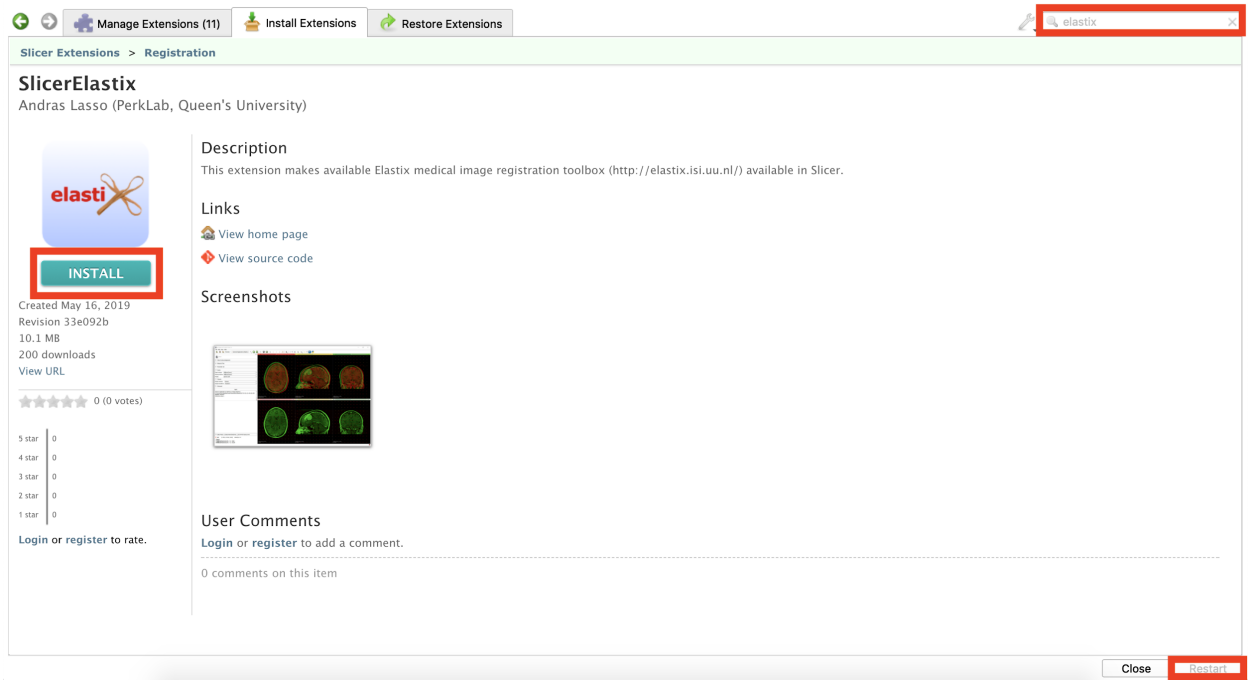
For electrodes visualisation on brain cortex we have to perform MRI and CT volumes registration. For this purpose we can use 3D Slicer software.



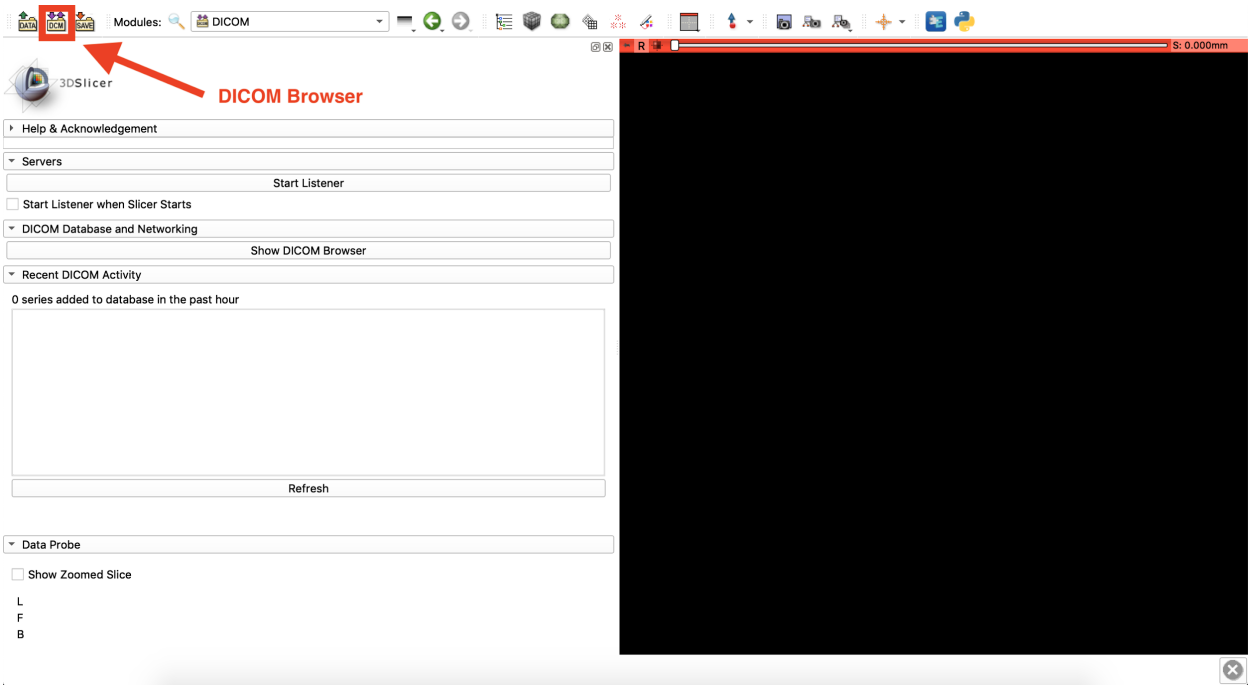
To obtain fine result ElastiX plugin can be used. Use Extensions Manager to install ElastiX plugin in 3D Sliser.



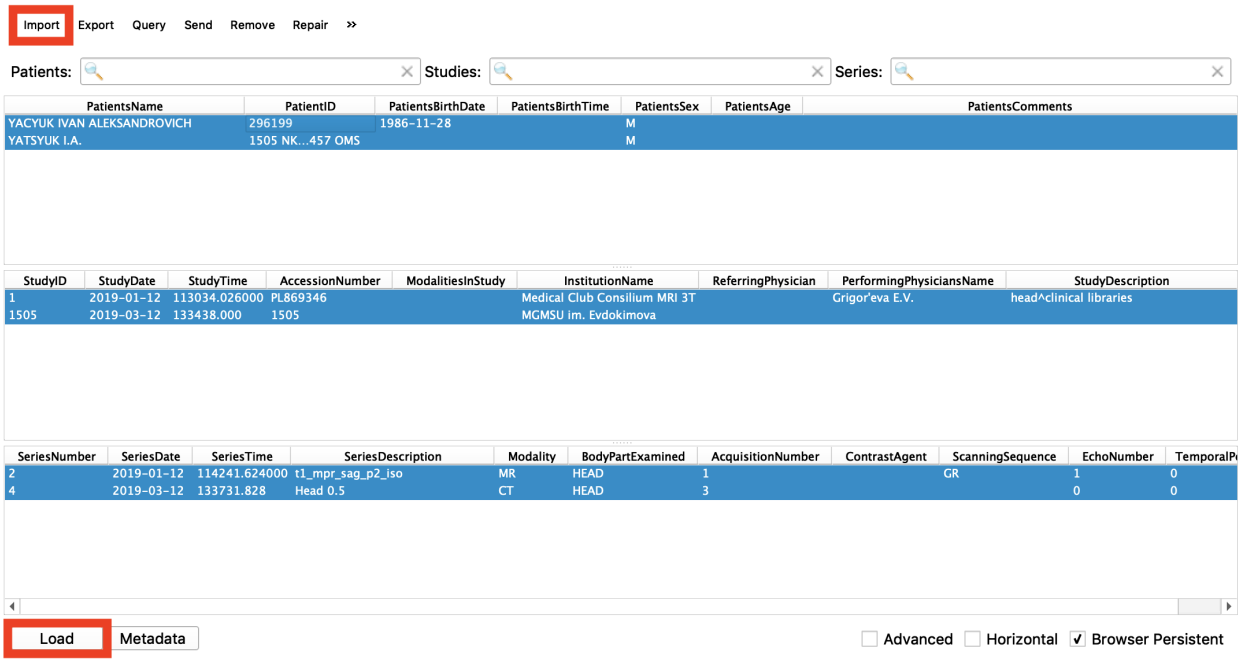
You can find ElastiX plugin using search field. After installation 3D Slicer have to be restart to activate plugin.



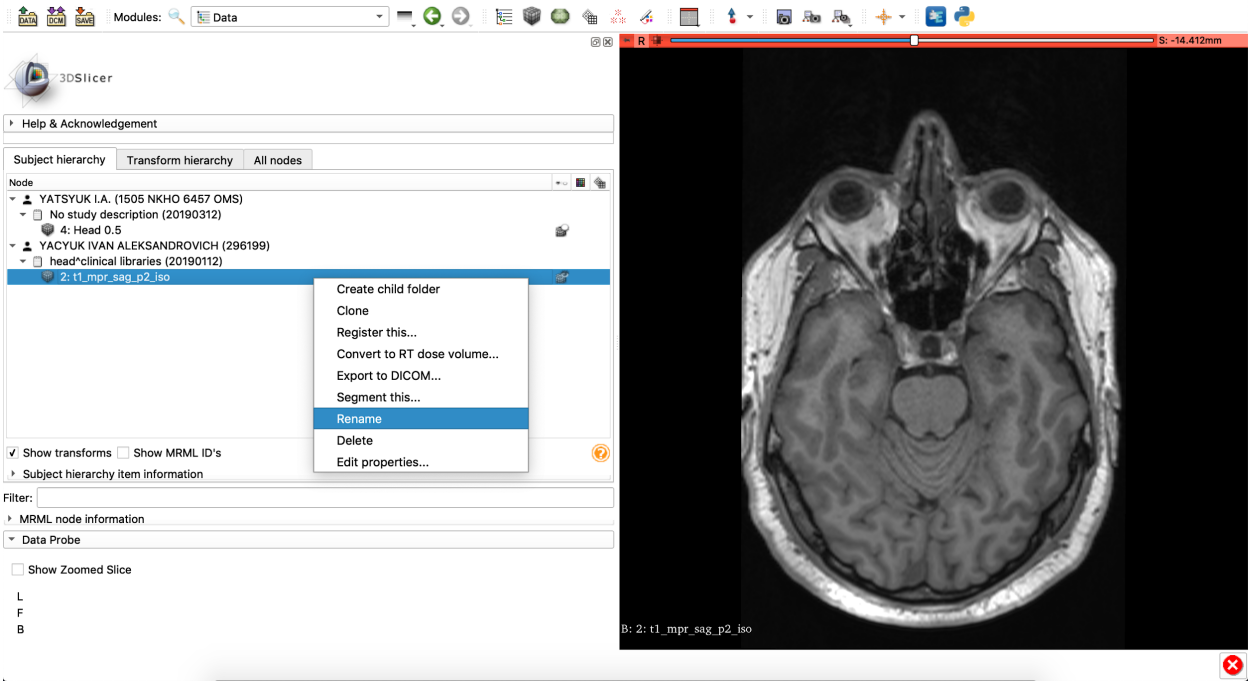
DICOM data can be loaded using DICOM browser



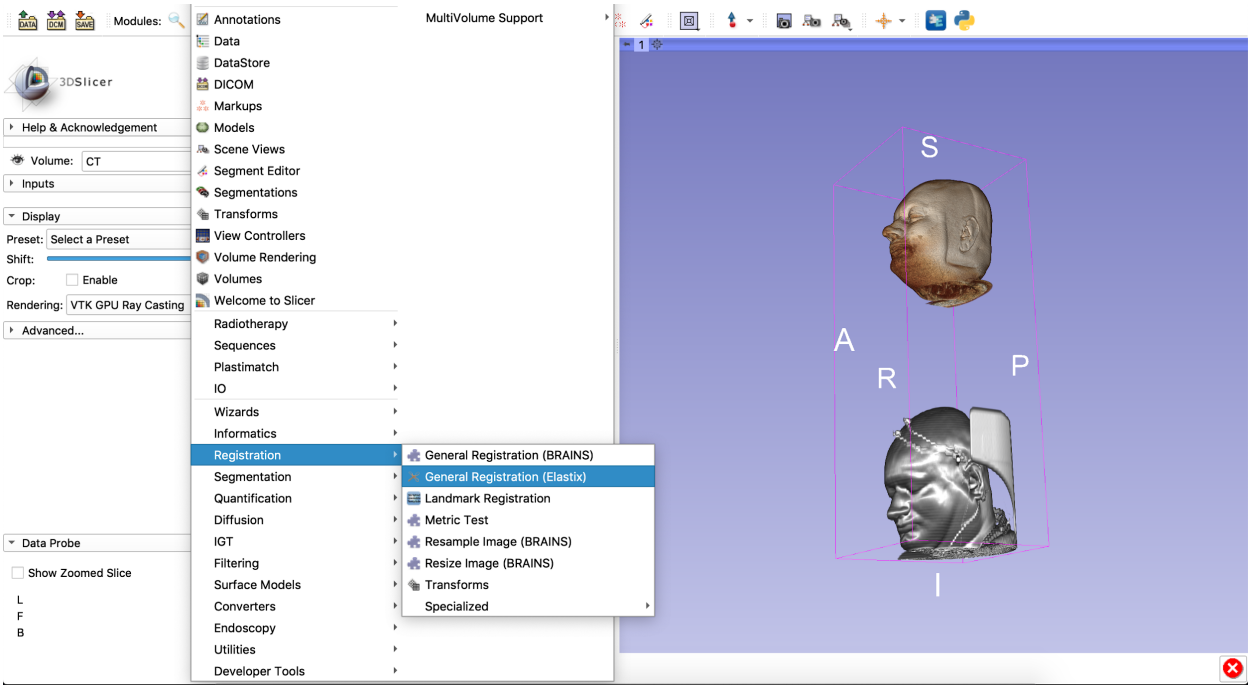
Firstly CT and MRI scans have to be imported to DICOM Browser. Then they can be loaded to 3D Slicer work space.



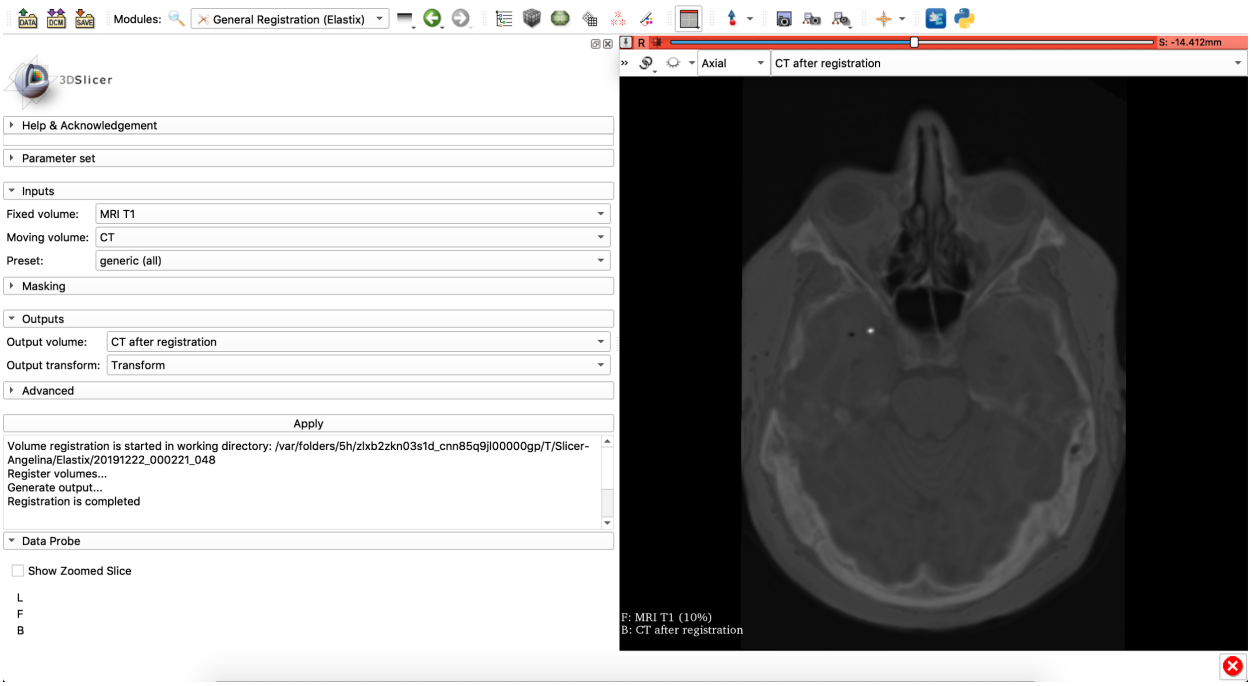
The data can be renamed to facilitate further manipulations.



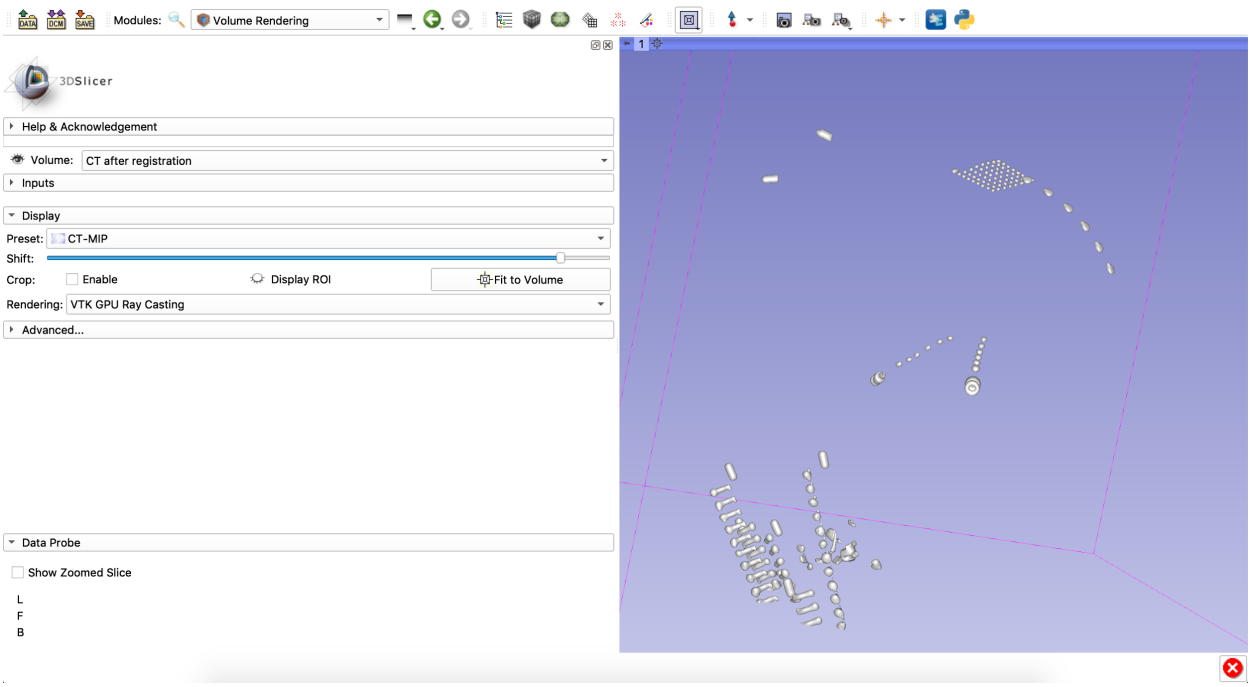
In Volume Rendering workspace we can see that CT and MRI volumes are not aligned. So we have to perform co-registration using ElastiX plugin.



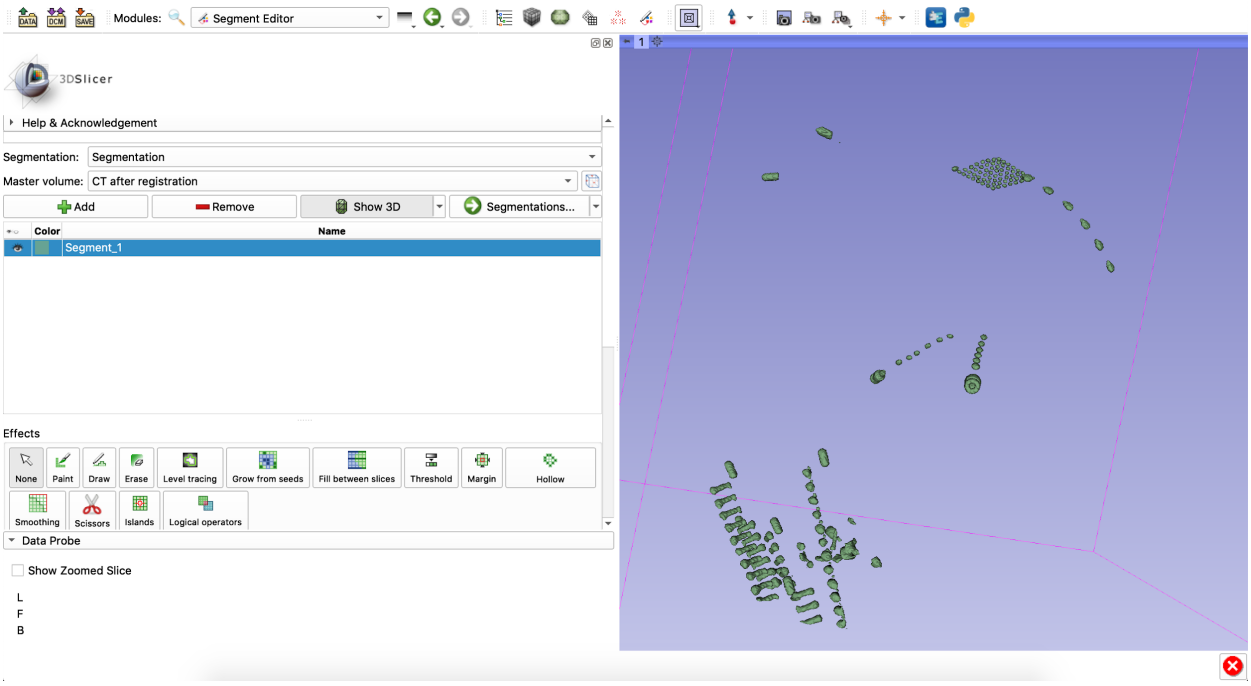
To run ElastiX registration Inputs and Outputs have to be specified.



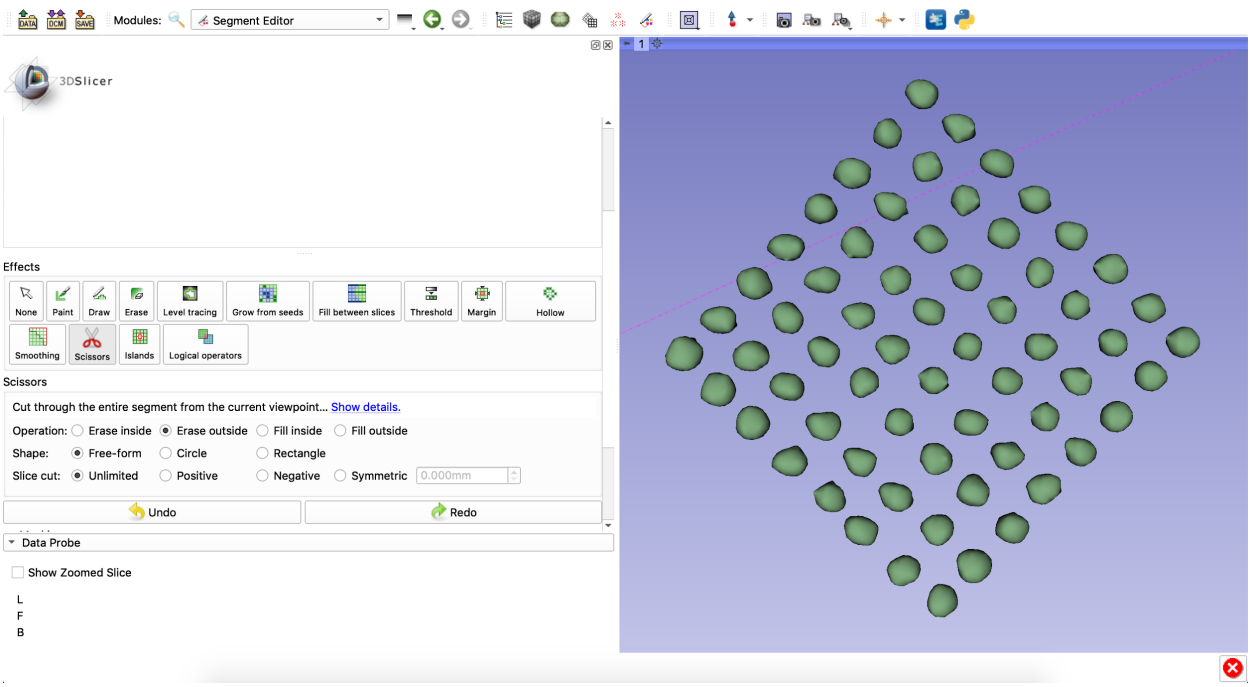
After co-registration we can extract electrodes as segmentation.



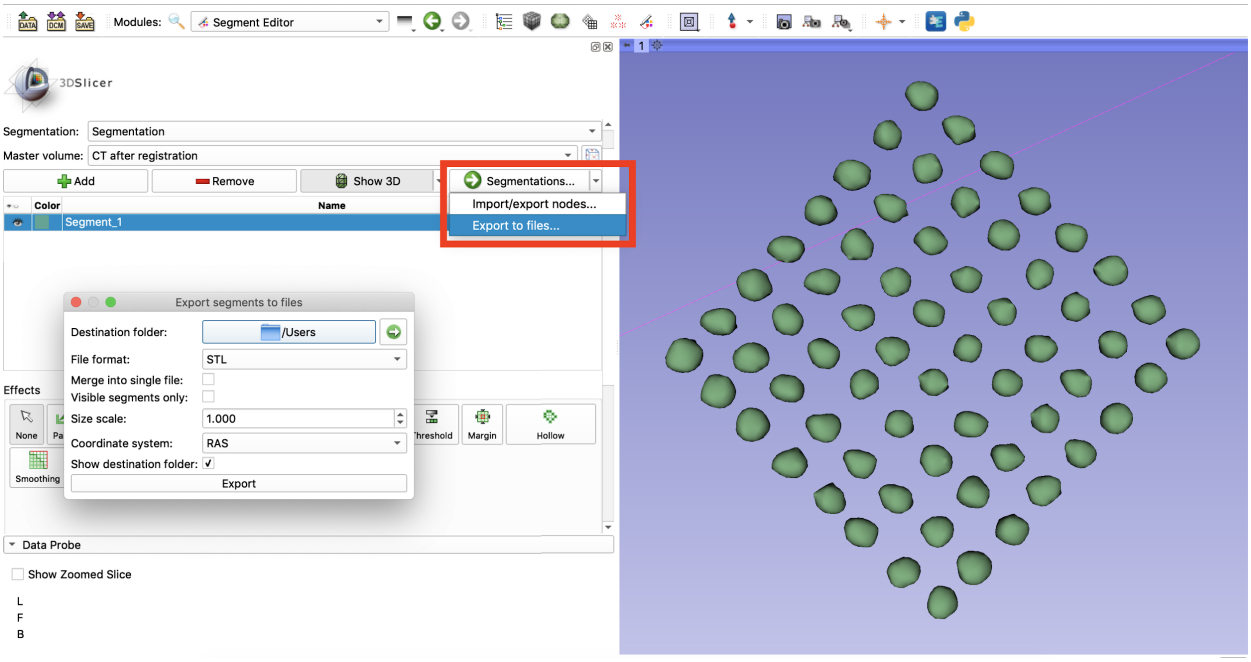
All electrodes can be extracted using threshold module.



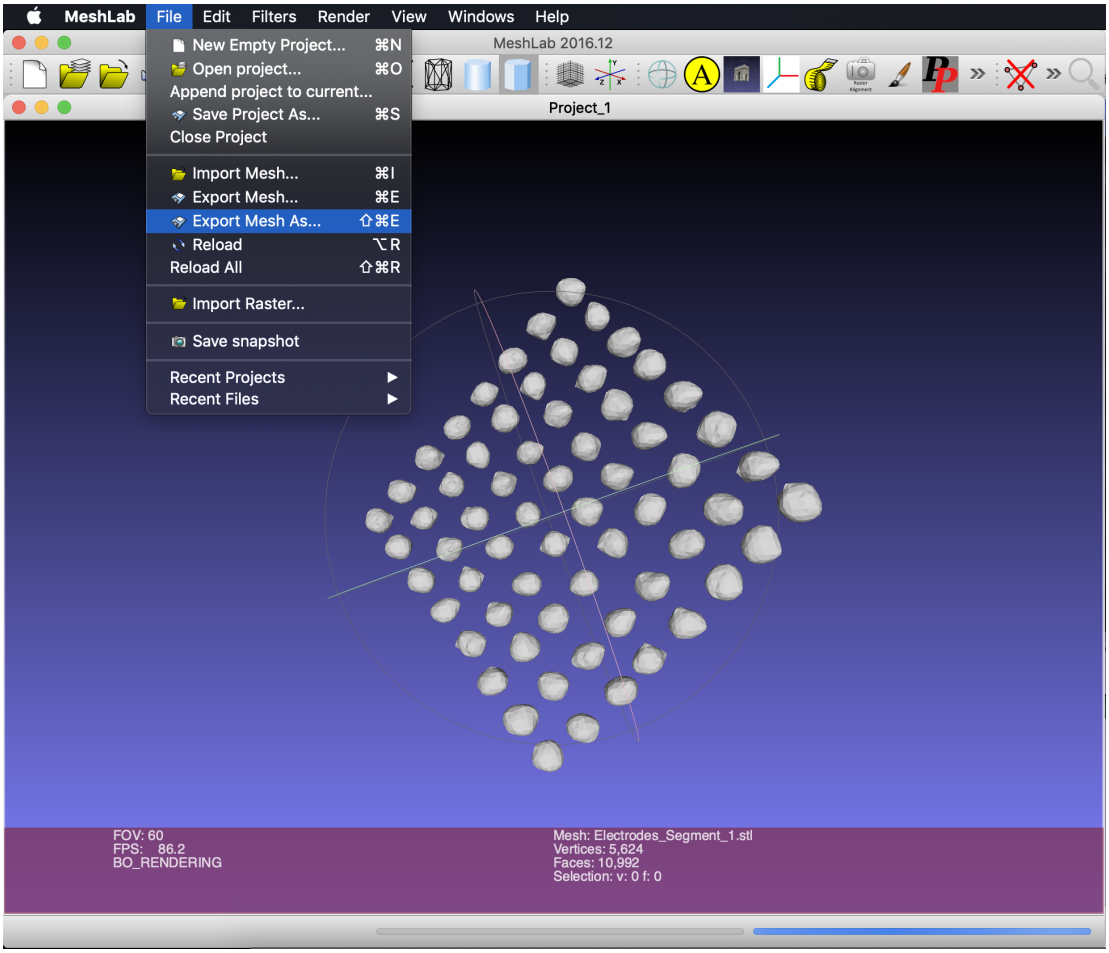
Then appropriate electrodes can be extracted using scissors



Export segmentation

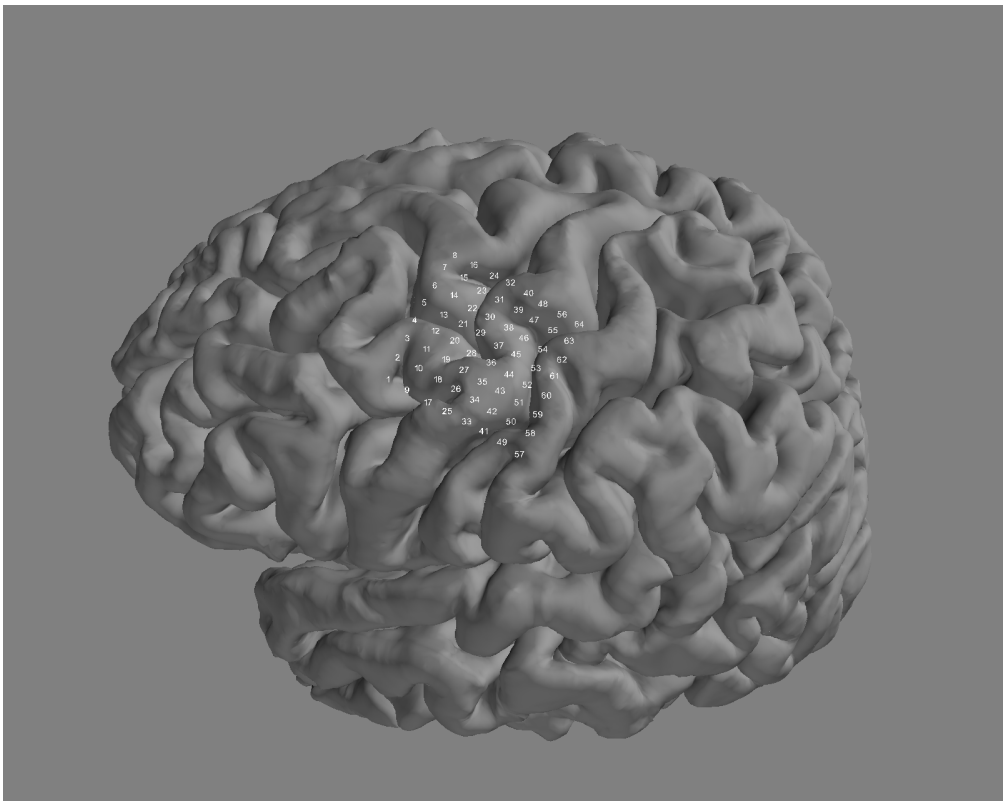


To be processed in Python .stl file have to be converted to .xyz format. For this purpose MeshLab software can be used. Export mesh as .xyz without normals.

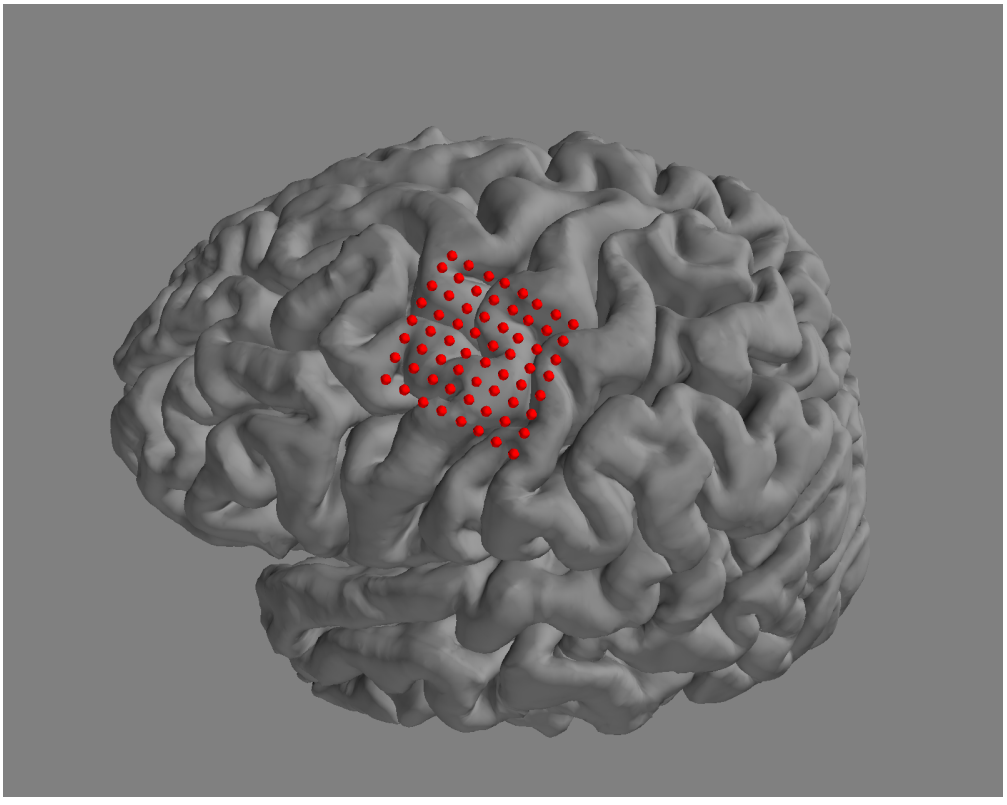


After all preparations data can be loaded to open source cross platform software for visualisation of ECoG data on cortex surface developed by us.
In the first block we carry out all processing for further ECoG data visualisation.

We can plot electrodes as numbers to check their order

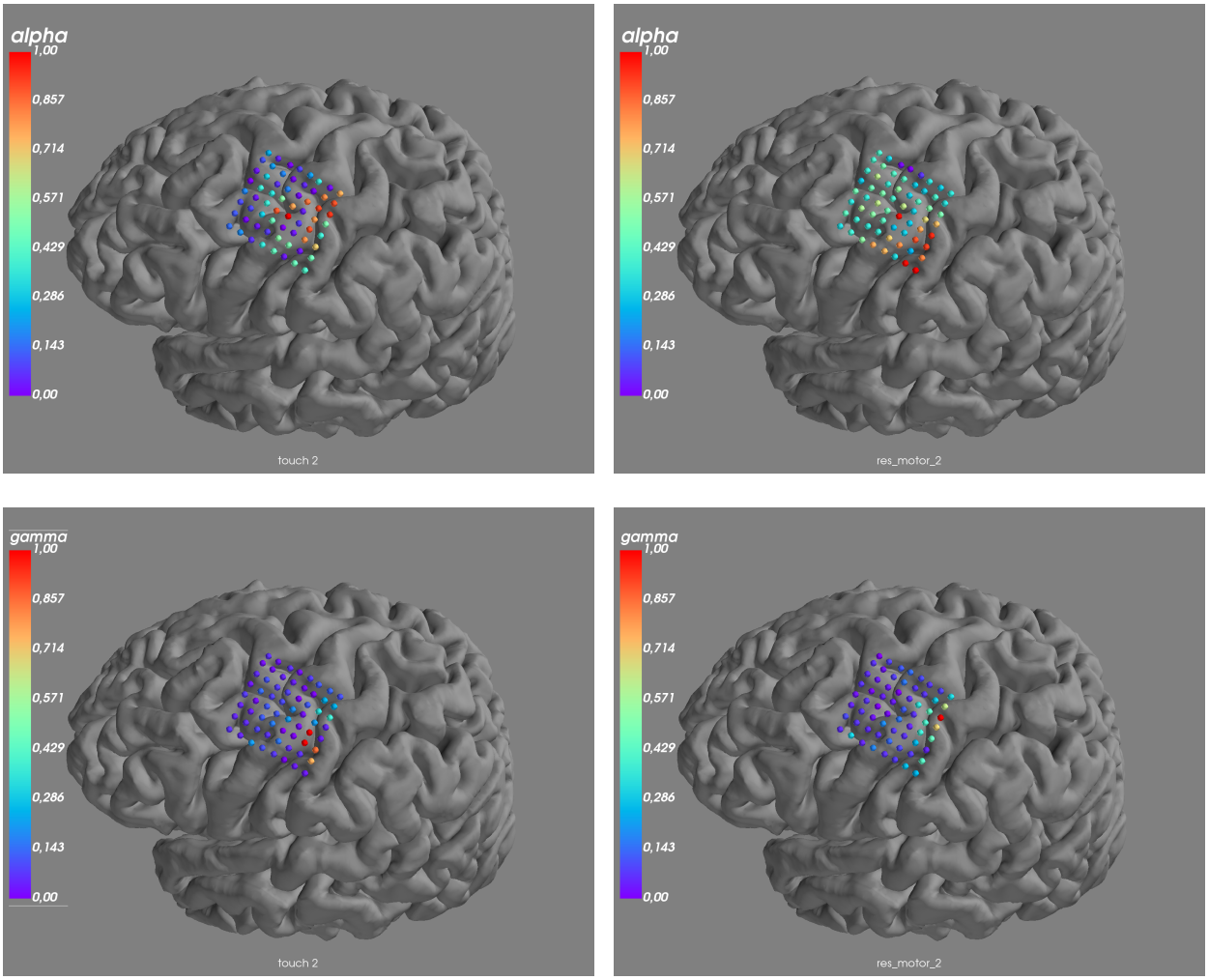


We can plot electrodes as spheres to check their locations.

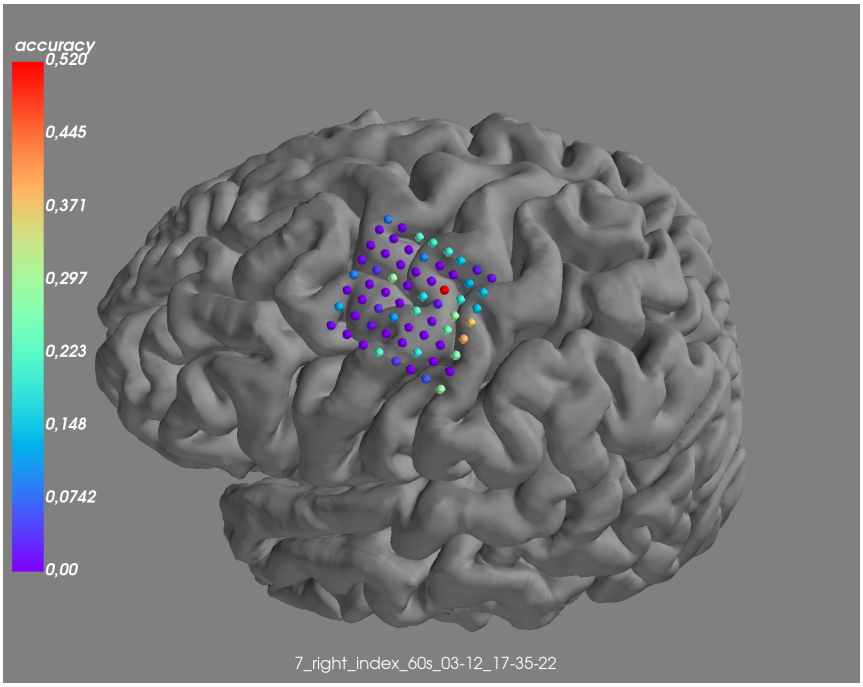


In the second block we can visualise ECoG data on electrodes and save results if needed.

Here are some examples of ECoG data visualisation. (4 pictures panel)
Alpha and gamma motor and sensor activity.



Accuracy of fingers movement decoding.



As electrodes are connected in grid we can model mesh deformation using thin plate spline.