

NFT & NIST

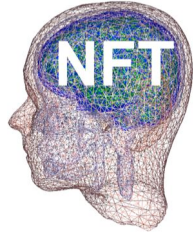
Neuroelectromagnetic Forward and Inverse Head Modeling Toolbox

Zeynep AKALIN ACAR

22nd EEGLAB Workshop, San Diego

November, 2016

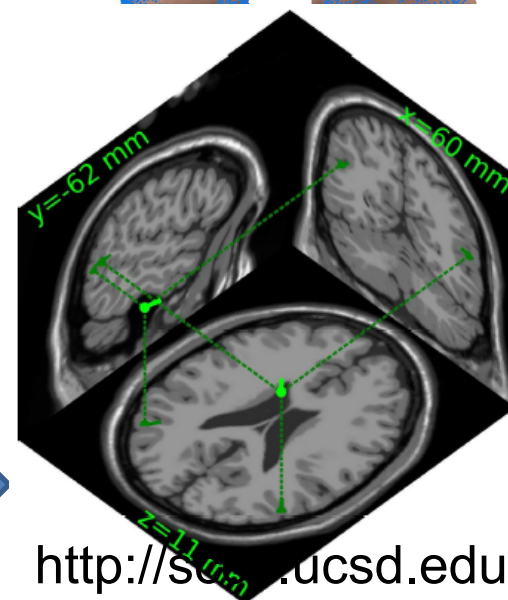
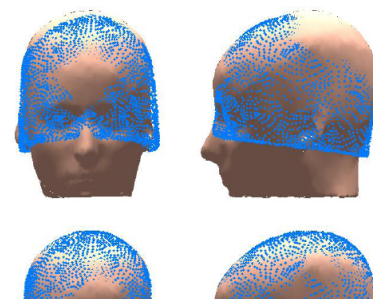
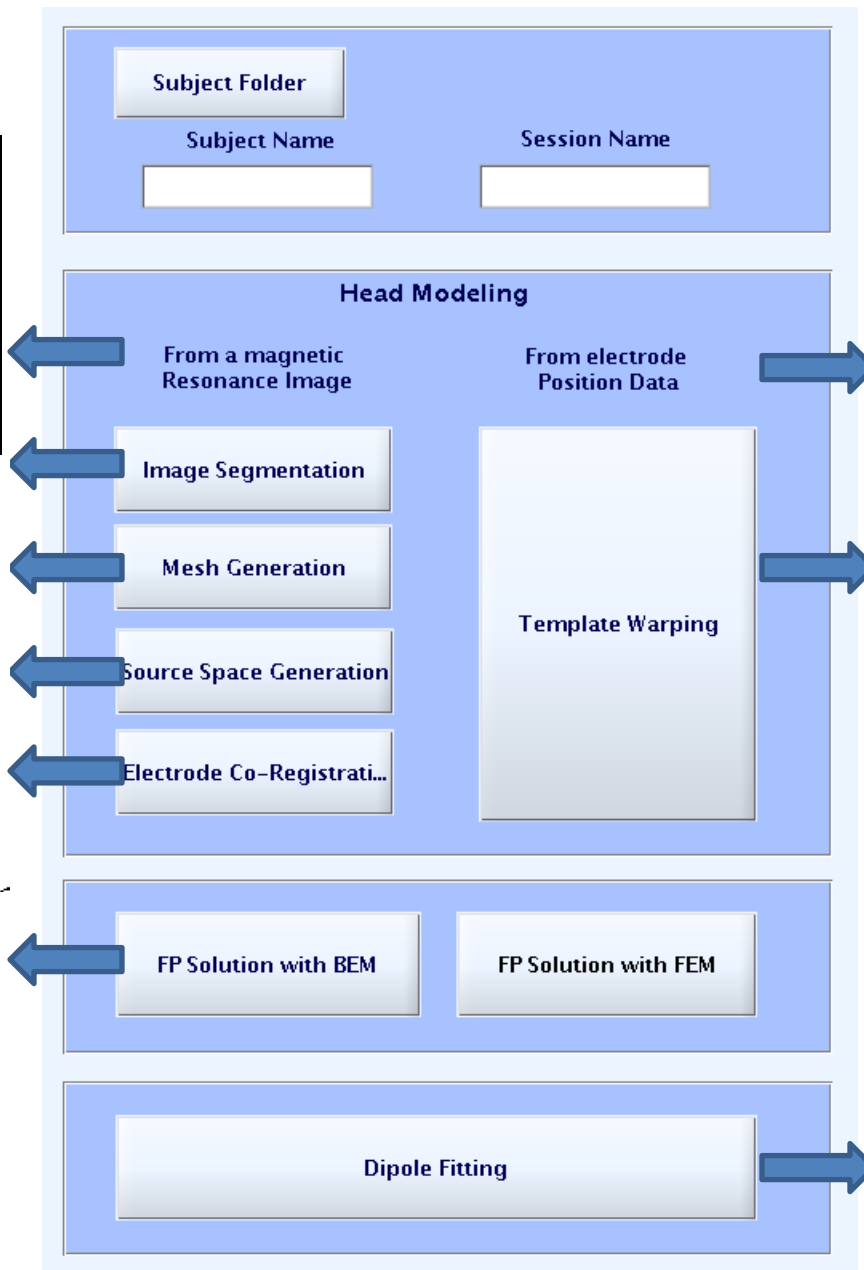
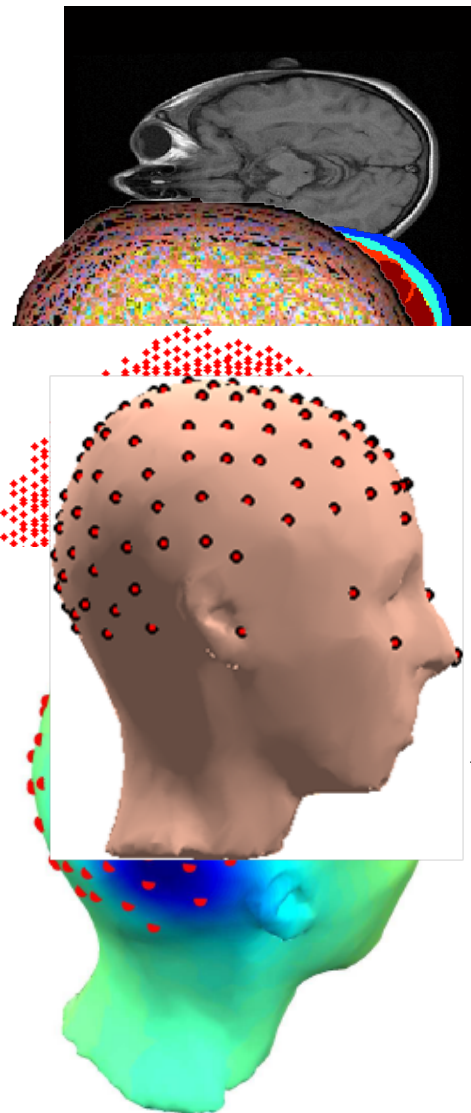
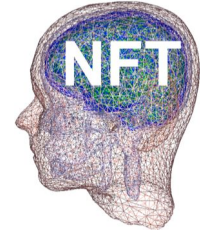
NFT



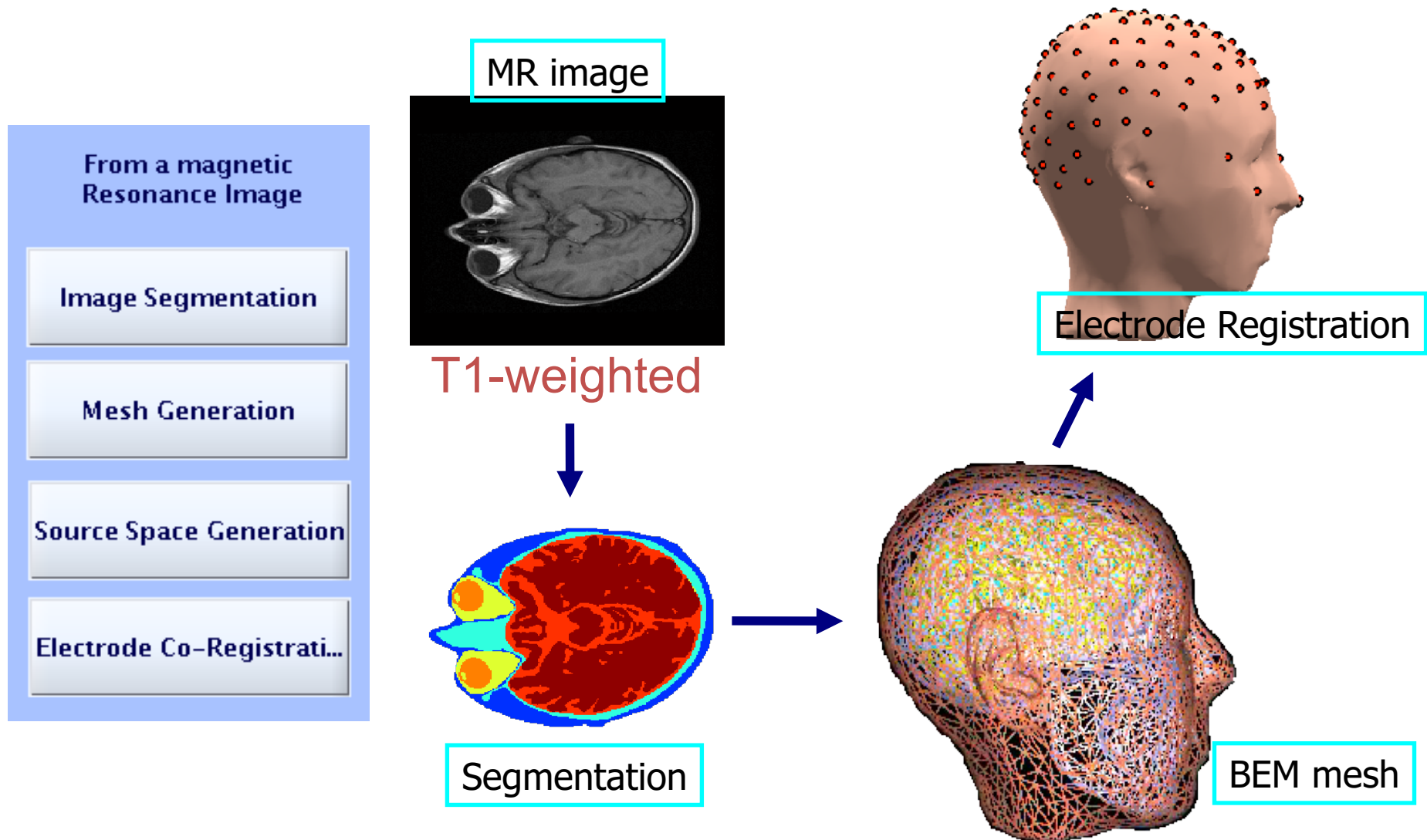
- ◆ A complete framework for accurate forward problem solution.
- ◆ Easy-to-use MATLAB environment with GUI and command-line functions.
- ◆ Ability to use available subject information
 - T1-weighted 3D MR images
 - Digitized sensor (electrode) locations

Comparison with Dipfit

- ◆ The realistic model in Dipfit is a three-layer MNI head model represented with 3000 vertices.
 - The forward matrices are pre-calculated, so there is no need for FP calculations.
- ◆ NFT generates subject-specific models.
 - NFT does model generation and forward problem calculations.
 - More accurate.



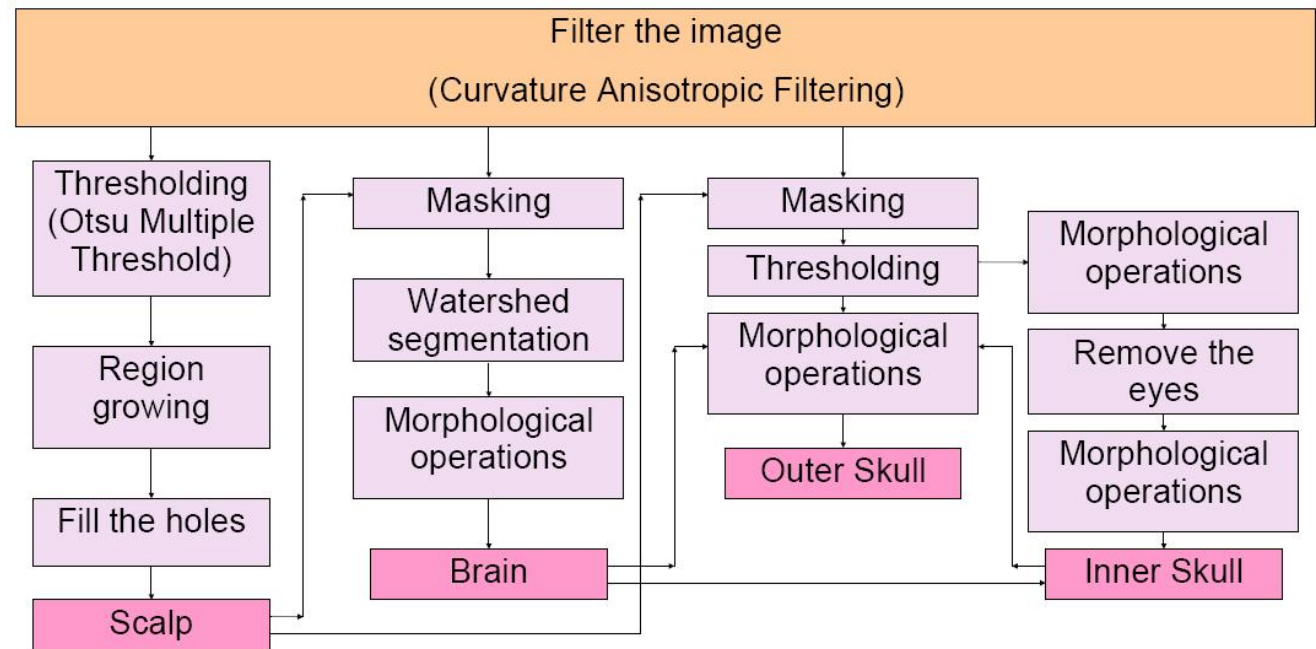
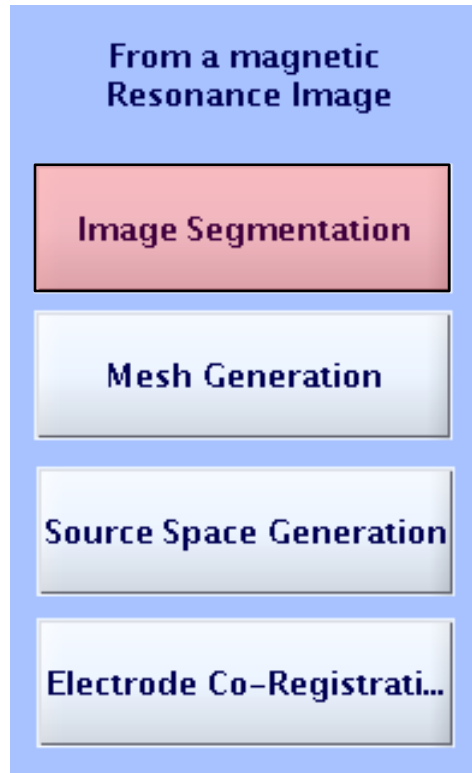
Head modeling from MR images



Preparing the MR Image

- ◆ Using FreeSurfer
 - Inhomogeneity correction
 - Convert to 1x1x1 volume
 - Arrange direction of the image
 - Save in analyze format

Image Segmentation



Classifies four tissues from T1-weighted images
Scalp, Skull, CSF and Brain

Starting NFT

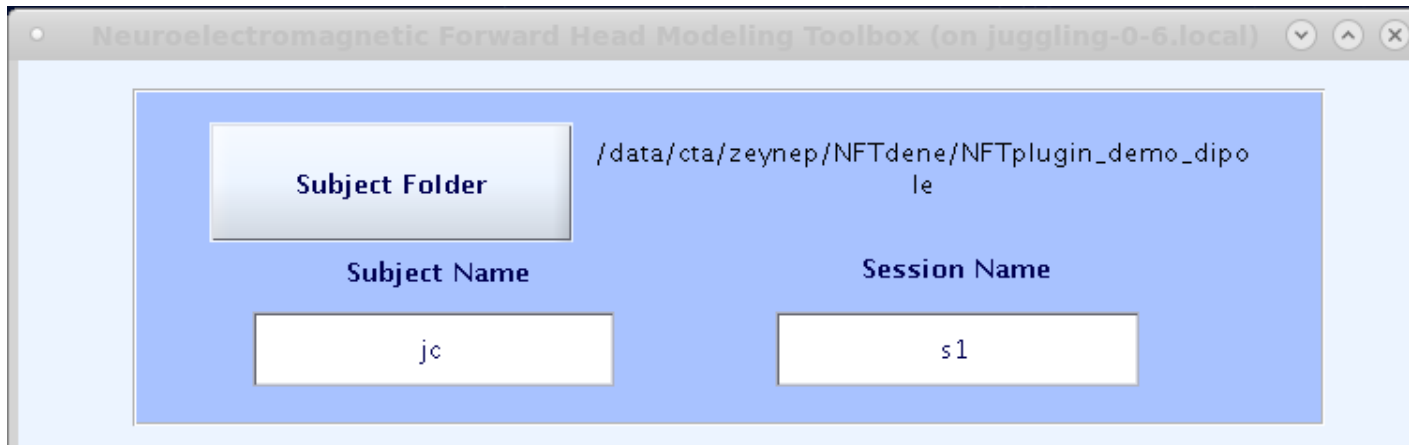
- ◆ To start from EEGLAB
 - EEGLAB -> Tools -> NFT
 - ◆ To start as a standalone toolbox
 - addpath NFT directory
 - Type 'NFT' in Matlab
- For demo: go to NFT-2.4_demo folder

Subject Selection

Subject Folder	
Subject Name	Session Name
<input type="text"/>	<input type="text"/>

- ◆ Select subject folder
- ◆ Specify subject name
- ◆ Specify session name

Subject Selection



The screenshot shows a software window titled "Neuroelectromagnetic Forward Head Modeling Toolbox (on juggling-0-6.local)". Inside the window, there is a light blue panel with the following elements:

- A "Subject Folder" button with the text "/data/cta/zeynep/NFTdene/NFTplugin_demo_dipole" next to it.
- A "Subject Name" label above a text input field containing "jc".
- A "Session Name" label above a text input field containing "s1".

Select current folder as subject folder
Enter "jc" as subject name
Enter "s1" as the session name

Image Segmentation

NFT: MR segmentation

File

(x,y,z)=

Coronal view

Axial view

Sagittal view

Display Image

- ☒ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/projects/zeynep/comm on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

66 Cerebellar low point

x 135

y 135 White matter seed point

z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Image Segmentation

Load image

NFT: MR segmentation

File

Open ...
Close

Coronal view

Axial view

Sagittal view

Display Image

☒ MR image
☐ Filtered image
☐ Scalp mask
☐ Brain mask
☐ Outer skull mask
☐ Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm
on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations
3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

66 Cerebellar low point

x 135
y 135 White matter seed point
z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Segmentation

Load image test2c.img

NFT: MR segmentation

File

(x,y,z)=

Coronal view

Sagittal view

Select File to Open

Look In: jo

deneme MNIdeneme
deneme_r MNIdeneme2
electrode MNlquad
electrode2 NFT-ani
electrode_reduced sil
fem skull_cond
FS symm
jonton jo_ori.hdr
mag mri.hdr

File Name: mri.hdr

Files of Type: (*.hdr)

Open Cancel

Open selected file

Outer skull mask
Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm
on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R Check inhomogeneity

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

66 Set Cerebellar low point

x 135

y 135 Set White matter seed point

z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Set Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Segmentation

Run filtering

NFT: MR segmentation (on juggling-0-6.local)

File

(x,y,z)= (128, 128, 128)

Coronal view

Axial view

Sagittal view

Display Image

- ☒ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image

Segmentation

Image Segmentation

☐ Swap LJR

1. Anisotropic Filtering

Number of iterations: 5

Image diffusion: 3

2. Scalp Segmentation

3. Brain Segmentation

Cerebellar low point: 66

White matter seed point: x: 135, y: 135, z: 110

Fill level: 0.4 [0, 1] Threshold: 0.4 [0, 1]

4. Outer Skull Segmentation

Center of one eye: z: 110

5. Inner Skull Segmentation

Segmentation

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (128, 128, 128)

Coronal view

Axial view

Sagittal view

Display Image

- ☒ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image

Segmentation

Image Segmentation

☐ Swap LJR

Check inhomogeneity

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

66 Set Cerebellar low point

x 135

y 135 Set White matter seed point

z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Set Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Run anisotropic filtering

Segmentation

View filtered image

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (128, 128, 128)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☒ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeypn/NFTdne/NFTplugin_demo_dipole

Filtered Image

Segmentation

Image Segmentation

☐ Swap LJR

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

66 Cerebellar low point

x 135

y 135 White matter seed point

z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Center of one eye

5. Inner Skull Segmentation

< Prev Next >

Image is filtered!

Segmentation

Click 'Next' for scalp segmentation and run scalp segmentation

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (128, 128, 128)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☒ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeynep/NFTdne/NFTplugin_demo_dipole

Filtered Image

Segmentation

Image Segmentation

☐ Swap L/R

Check inhomogeneity

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

66 Set Cerebellar low point

x 135

y 135 Set White matter seed point

z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Set Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Image is filtered!

Segmentation

View scalp mask

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (128, 128, 128)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☒ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeynep/NFTdne/NFTplugin_demo_dipole

Filtered Image

Segmentation

Image Segmentation

☐ Swap L/R

Check inhomogeneity

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

66 Set Cerebellar low point

x 135

y 135 Set White matter seed point

z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Set Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Scalp segmented!

Segmentation

Click 'Next' for brain segmentation

Selection of cerebellar low point

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (128, 176, 92)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☒ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeynep/NFTdne/NFTplugin_demo_dipole

Filtered Image Segmentation

Image Segmentation

☐ Swap LJR

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

92 Cerebellar low point

x 135 White matter seed point

y 135

z 110

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Scalp segmented!

Segmentation

Selection of a white matter point

NFT: MR segmentation (on juggling-0-6.local)

File

(x,y,z)= (149, 176, 180)

z

200

150

100

50

x

50 100 150 200 250

Coronal view

y

50

100

150

200

250

x

50 100 150 200 250

Axial view

z

50

100

150

200

250

y

50

100

150

200

250

x

50 100 150 200 250

Sagittal view

Display Image

- ☐ MR image
- ☒ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image Segmentation

Image Segmentation

☐ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

92 Cerebellar low point

x 176 White matter seed point

y 180

z 149

0.4 Fill level [0, 1] 0.4 Threshold [0, 1]

4. Outer Skull Segmentation

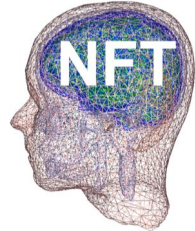
z 110 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Scalp segmented!

Segmentation



View brain mask

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (149, 176, 180)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☒ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image

Segmentation

Image Segmentation

☐ Swap L/R

Check inhomogeneity

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

92 Set Cerebellar low point

x 176

y 180 Set White matter seed point

z 149

0.35 Fill level [0, 1] 0.35 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Set Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

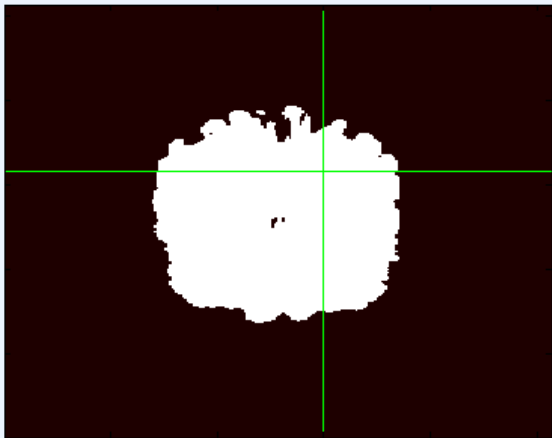
Brain segmented!

Segmentation

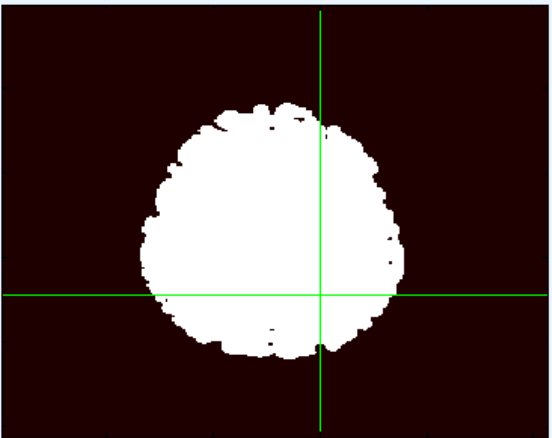
Click 'Next' for skull segmentation

File NFT: MR segmentation

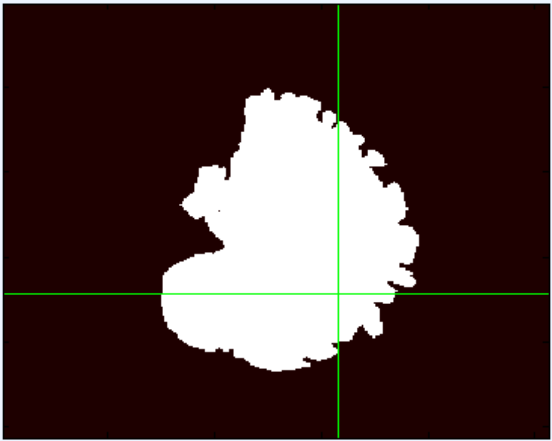
(x,y,z) = (150, 172, 158)



Coronal view



Axial view



Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☒ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm
on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

x 172

y 158 White matter seed point

z 150

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

z 110 Center of one eye

5. Inner Skull Segmentation

< Prev **Run** Next >

Brain segmented!

Segmentation

Select a slice for eyes and click 'set'

NFT: MR segmentation (on juggling-0-6.local)

File

(x,y,z)= (149, 68, 142)

z

200

150

100

50

x

50

100

150

200

250

Coronal view

y

50

100

150

200

250

x

50

100

150

200

250

Axial view

Display Image

☐ MR image

☒ Filtered image

☐ Scalp mask

☐ Brain mask

☐ Outer skull mask

☐ Inner skull mask

Save Results

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image Segmentation

Image Segmentation

☐ Swap L/R

Check inhomogeneity

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

92 Set Cerebellar low point

x 176

y 180 Set White matter seed point

z 149

0.35 Fill level [0, 1] 0.35 Threshold [0, 1]

4. Outer Skull Segmentation

z 142 Set Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Brain segmented!

Segmentation

Click 'Run' for skull segmentation

NFT: MR segmentation (on juggling-0-6.local)

File (x,y,z)= (149, 68, 142)

z

200

150

100

50

x

50 100 150 200 250

Coronal view

y

50

100

150

200

250

x

50 100 150 200 250

Axial view

z

50

100

150

200

250

y

50

100

150

200

250

x

50 100 150 200 250

Sagittal view

Display Image

- ☐ MR image
- ☒ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image Segmentation

Image Segmentation

☐ Swap LJR

1. Anisotropic Filtering

Number of iterations

Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

Cerebellar low point

x

y White matter seed point

z

Fill level [0, 1] Threshold [0, 1]

4. Outer Skull Segmentation

z Center of one eye

5. Inner Skull Segmentation

Segmenting skull...

Segmentation

Click on the eyes

NFT: MR segmentation

Figure 2

File Edit View Insert Tools Desktop Window Help

(x,y,z)= (150, 67, 95)

Coronal view

Sagittal view

Brain mask
Outer skull mask
Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm
on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

172 White matter seed point

158 White matter seed point

150 White matter seed point

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

95 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Segmenting skull...

Segmentation

NFT: MR segmentation

Figure 2

File Edit View Insert Tools Desktop Window Help

(x,y,z)= (150, 67, 95)

Coronal view

Sagittal view

Brain mask
Outer skull mask
Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

172 White matter seed point

158 White matter seed point

150 White matter seed point

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

95 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Segmenting skull...

Segmentation

View skull segmentation

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (149, 68, 142)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☒ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder /data/cta/zeynep/NFTdne/NFTplugin_demo_dipole

Filtered Image Segmentation

Image Segmentation

☐ Swap LJR

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

92 Cerebellar low point

x 176

y 180 White matter seed point

z 149

0.35 Fill level [0, 1] 0.35 Threshold [0, 1]

4. Outer Skull Segmentation

z 142 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Skull segmented!

Segmentation

Click 'Next' for CSF segmentation

NFT: MR segmentation (on juggling-0-6.local)

(x,y,z)= (149, 68, 142)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☒ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder: /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image

Segmentation

Image Segmentation

☐ Swap L/R

1. Anisotropic Filtering

Number of iterations: 5

Image diffusion: 3

2. Scalp Segmentation

3. Brain Segmentation

Cerebellar low point: 92

White matter seed point: x: 176, y: 180, z: 149

Fill level [0, 1]: 0.35 Threshold [0, 1]: 0.35

4. Outer Skull Segmentation

Center of one eye: z: 142

5. Inner Skull Segmentation

Skull segmented!

Segmentation

Click 'Run' for CSF segmentation

NFT: MR segmentation (on juggling-0-6.local)

File (x,y,z)= (149, 68, 142)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☒ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image Segmentation

Image Segmentation

☐ Swap L/R Check inhomogeneity

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

92 Set Cerebellar low point

x 176

y 180 Set White matter seed point

z 149

0.35 Fill level [0, 1] 0.35 Threshold [0, 1]

4. Outer Skull Segmentation

z 142 Set Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Segmenting CSF...

Segmentation

NFT: MR segmentation (on juggling-0-6.local)

File

(x,y,z)= (149, 68, 142)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☒ Outer skull mask
- ☐ Inner skull mask

Save Results

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Filtered Image Segmentation

Image Segmentation

☐ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

92 Cerebellar low point

x 176

y 180 White matter seed point

z 149

0.35 Fill level [0, 1] 0.35 Threshold [0, 1]

4. Outer Skull Segmentation

z 142 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Correcting skull and scalp...

Segmentation

View CSF segmentation

NFT: MR segmentation

File

(x,y,z) = (150, 160, 139)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☒ Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

x 172

y 158 White matter seed point

z 150

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

z 95 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Segmentation complete!

Segmentation

Save filtered image

NFT: MR segmentation

File

(x,y,z) = (150, 160, 139)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☒ Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

x 172

y 158 White matter seed point

z 150

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

z 95 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Saving filtered image as SubjectA_filtered.mat

Segmentation

NFT: MR segmentation

File

(x,y,z) = (150, 160, 139)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☒ Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

x 172

y 158 White matter seed point

z 150

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

z 95 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Filtered image saved as SubjectA_filtered.mat

Segmentation

Save segmentation

NFT: MR segmentation

File

(x,y,z) = (150, 160, 139)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☒ Inner skull mask

Save Results

Output Folder /data/projects/zeynep/comm on/home zeynep/io/deneme

Filtered Image Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

x 172

y 158 White matter seed point

z 150

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

z 95 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Saving segmentation as SubjectA_segments.mat

Segmentation

NFT: MR segmentation

File

(x,y,z) = (150, 160, 139)

Coronal view

Axial view

Sagittal view

Display Image

- ☐ MR image
- ☐ Filtered image
- ☐ Scalp mask
- ☐ Brain mask
- ☐ Outer skull mask
- ☒ Inner skull mask

Save Results

Output Folder: /data/projects/zeynep/common/home_zevneb/io/deneme

Filtered Image: Segmentation

Image Segmentation

☒ Swap L/R

1. Anisotropic Filtering

5 Number of iterations

3 Image diffusion

2. Scalp Segmentation

3. Brain Segmentation

67 Cerebellar low point

x 172

y 158 White matter seed point

z 150

0.1 Fill level [0, 1] 0.1 Threshold [0, 1]

4. Outer Skull Segmentation

z 95 Center of one eye

5. Inner Skull Segmentation

< Prev Run Next >

Segmentation saved as SubjectA_segments.mat

Image Segmentation

```
Command Window
New to MATLAB? Watch this Video, see Demos, or read Getting Started.

>> dir SubjectA*

SubjectA_mri.mat      SubjectA_segments.mat

>> load SubjectA_mri
>> mri

mri =

    dim: [256 256 256]
   xgrid: [1x256 double]
   ygrid: [1x256 double]
   zgrid: [1x256 double]
 anatomy: [256x256x256 double]
 transform: [4x4 double]
    hdr: []

>> load SubjectA_segments
>> Segm

Segm =

    scalpmask: [256x256x256 logical]
    brainmask: [256x256x256 logical]
 outerskullmask: [256x256x256 logical]
 innerskullmask: [256x256x256 logical]
```

Mesh Generation

From a magnetic
Resonance Image

Image Segmentation

Mesh Generation

Source Space Generation

Electrode Co-Registrati...

NFT: Mesh generation (on juggling-0-6.local)

Load Segmentation /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_segments

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

4 # of layers Mesh name: jc

☒ Linear ☐ Quadratic

7000 Number of nodes per layer

☐ Local mesh refinement

2.1 Edge length/
Distance between meshes

Start Mesh Generation

Status

Generate linear FEM mesh Generate quadratic FEM mesh

Generate Mesh for a 3 or 4 layer head model

Mesh generation

Click local mesh refinement

NFT: Mesh generation (on juggling-0-6.local)

Load Segmentation /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_segments

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

of layers

Mesh name:

☒ Linear ☐ Quadratic

Number of nodes per layer

☒ Local mesh refinement

Edge length/
Distance between meshes

Start Mesh Generation

Status

Generate linear FEM mesh **Generate quadratic FEM mesh**

Mesh generation

NFT: Mesh generation (on juggling-0-6.local)

Load Segmentation /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_segments

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

of layers

Mesh name:

☒ Linear ☐ Quadratic

Number of nodes per layer

☒ Local mesh refinement

Edge length/
Distance between meshes

Start Mesh Generation

Mesh saved!

Generate linear FEM mesh **Generate quadratic FEM mesh**

Mesh generation

NFT: Mesh generation (on juggling-0-6.local)

Load Segmentation /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_segments

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

of layers

Mesh name:

☒ Linear ☐ Quadratic

Number of nodes per layer

☒ Local mesh refinement

Edge length/
Distance between meshes

Start Mesh Generation

Mesh saved!

Generate linear FEM mesh **Generate quadratic FEM mesh**

- ◆ `[C,E] = ReadSMF('Scalp.smf',0,0,0,1);`
- ◆ `Plotmesh(E(:,2:4),C(:,2:4))`

Mesh generation

NFT: Mesh generation (on juggling-0-6.local)

Load Segmentation /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_segments

Output Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

of layers

Mesh name:

☒ Linear ☐ Quadratic

Number of nodes per layer

☒ Local mesh refinement

Edge length/
Distance between meshes

Start Mesh Generation

Linear FEM mesh generated!

Generate linear FEM mesh

Generate quadratic FEM mesh

Source Space Generation

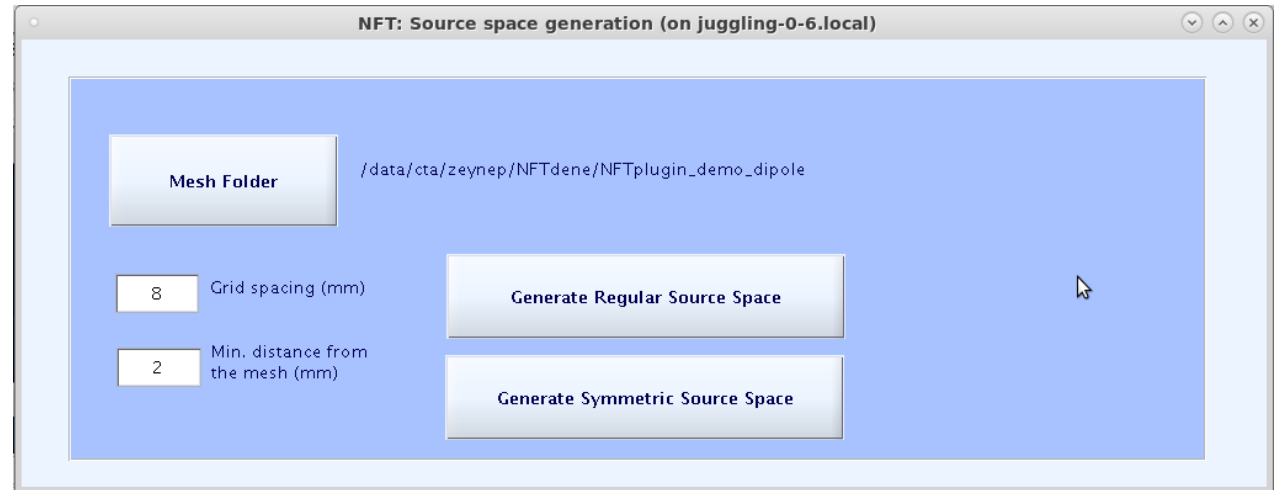
From a magnetic
Resonance Image

Image Segmentation

Mesh Generation

Source Space Generation

Electrode Co-Registrati...



Generates a simple source space:

Regular Grid inside the brain

With a given spacing and distance to the mesh

Source Space Generation

From a magnetic
Resonance Image

Image Segmentation

Mesh Generation

Source Space Generation

Electrode Co-Registrati...

NFT: Source space generation (on juggling-0-6.local)

Mesh Folder `/data/cta/zeynep/NFTdene/NFTplugin_demo_dipole`

Grid spacing (mm)

Min. distance from the mesh (mm)

Generate Regular Source Space

Generate Symmetric Source Space

Source space saved!

Electrode Co-registration

From a magnetic
Resonance Image

Image Segmentation

Mesh Generation

Source Space Generation

Electrode Co-Registrati...

NFT: Electrode co-registration (on juggling-0-6.local)

Load sensor locations

Electrode file name

Mesh Folder

/data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Initial co-registration

Translation

Rotation

Complete co-registration

Translation

Rotation

Save initial reg.

Save complete reg.

Electrode Co-registration

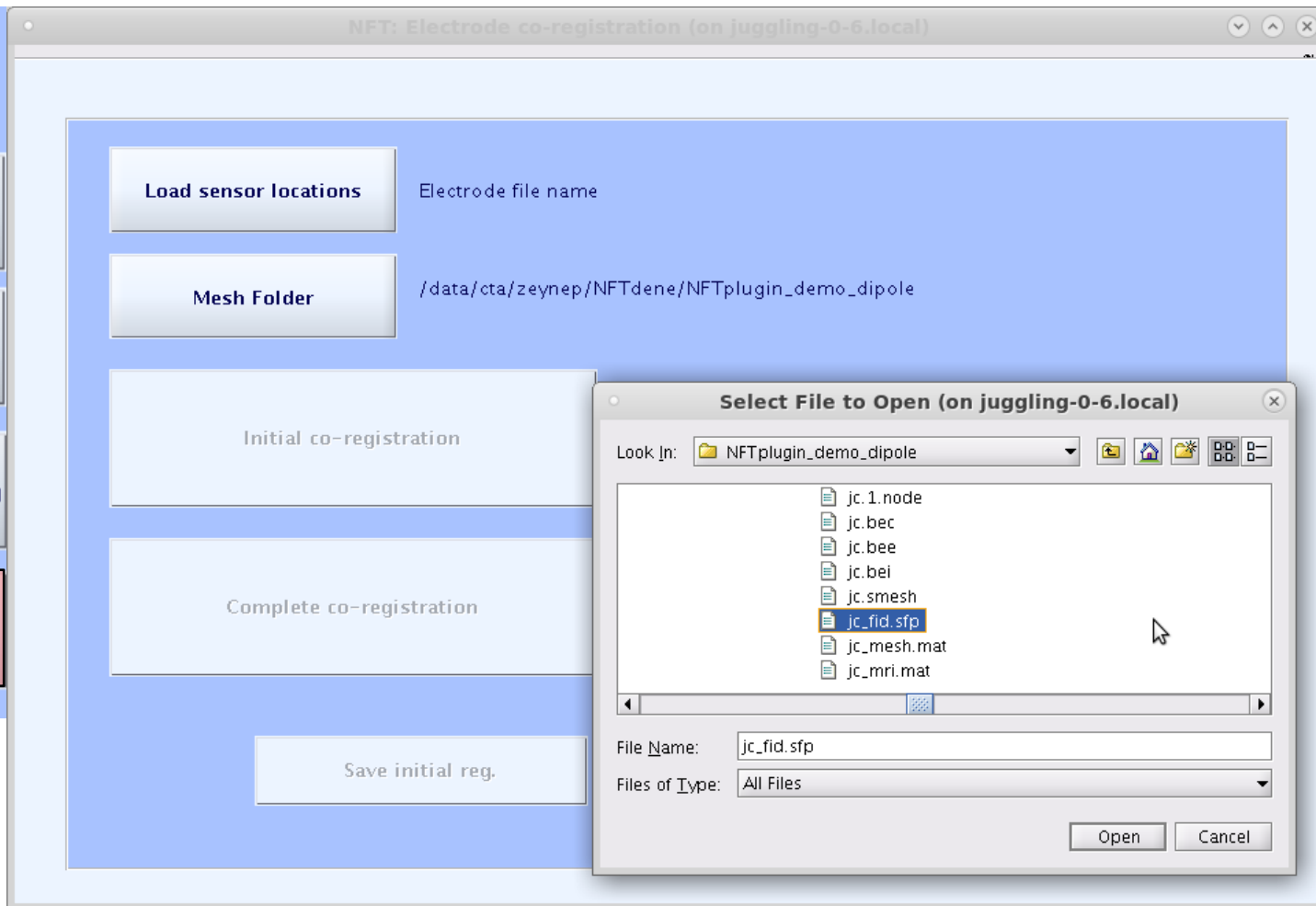
From a magnetic
Resonance Image

Image Segmentation

Mesh Generation

Source Space Generation

Electrode Co-Registrati...



Electrode Co-registration

From a magnetic
Resonance Image

Image Segmentation

Mesh Generation

Source Space Generation

Electrode Co-Registrati...

NFT: Electrode co-registration (on juggling-0-6.local)

Load sensor locations

/data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_fid.sfp

Mesh Folder

/data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Initial co-registration

Translation

Rotation

Complete co-registration

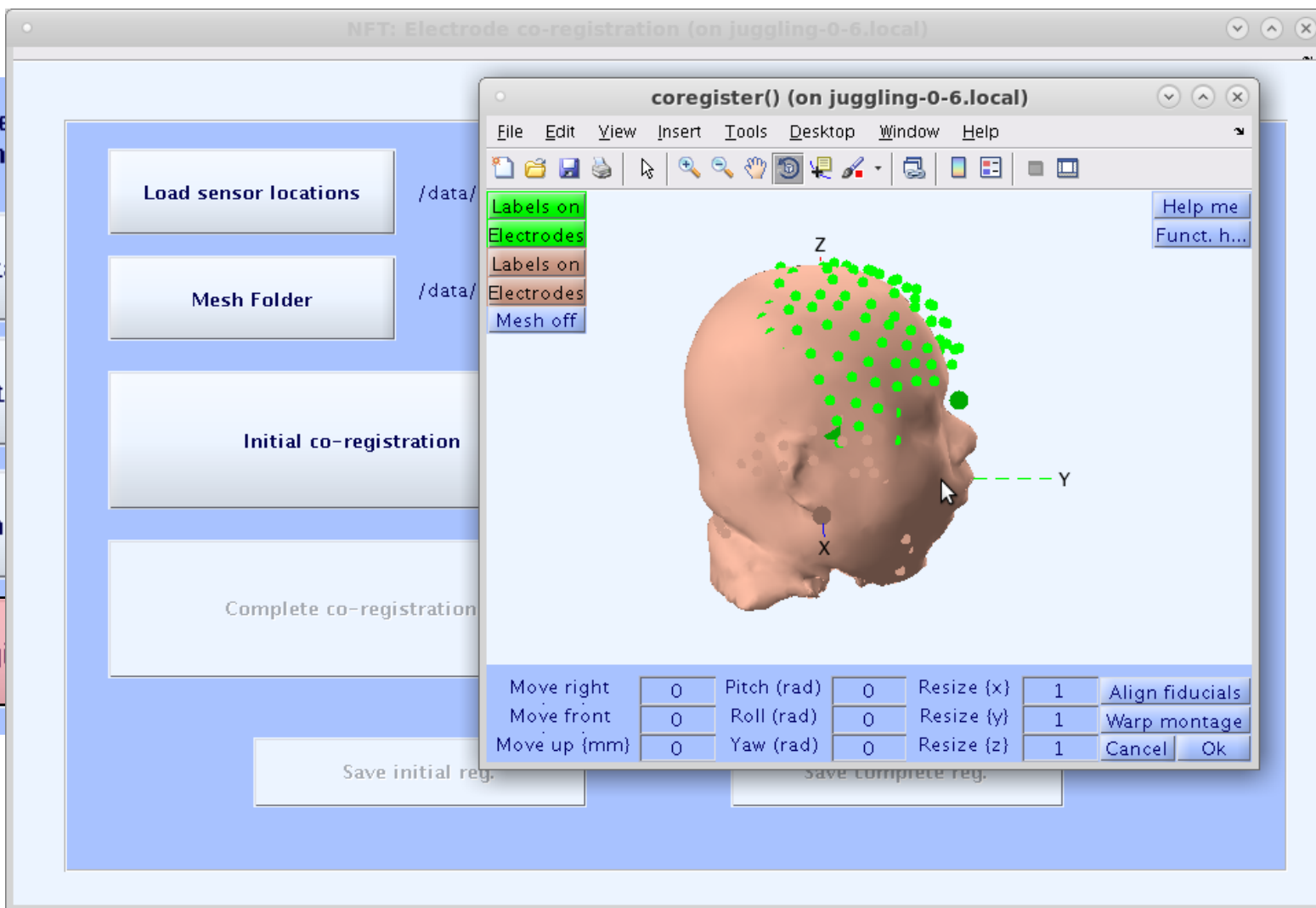
Translation

Rotation

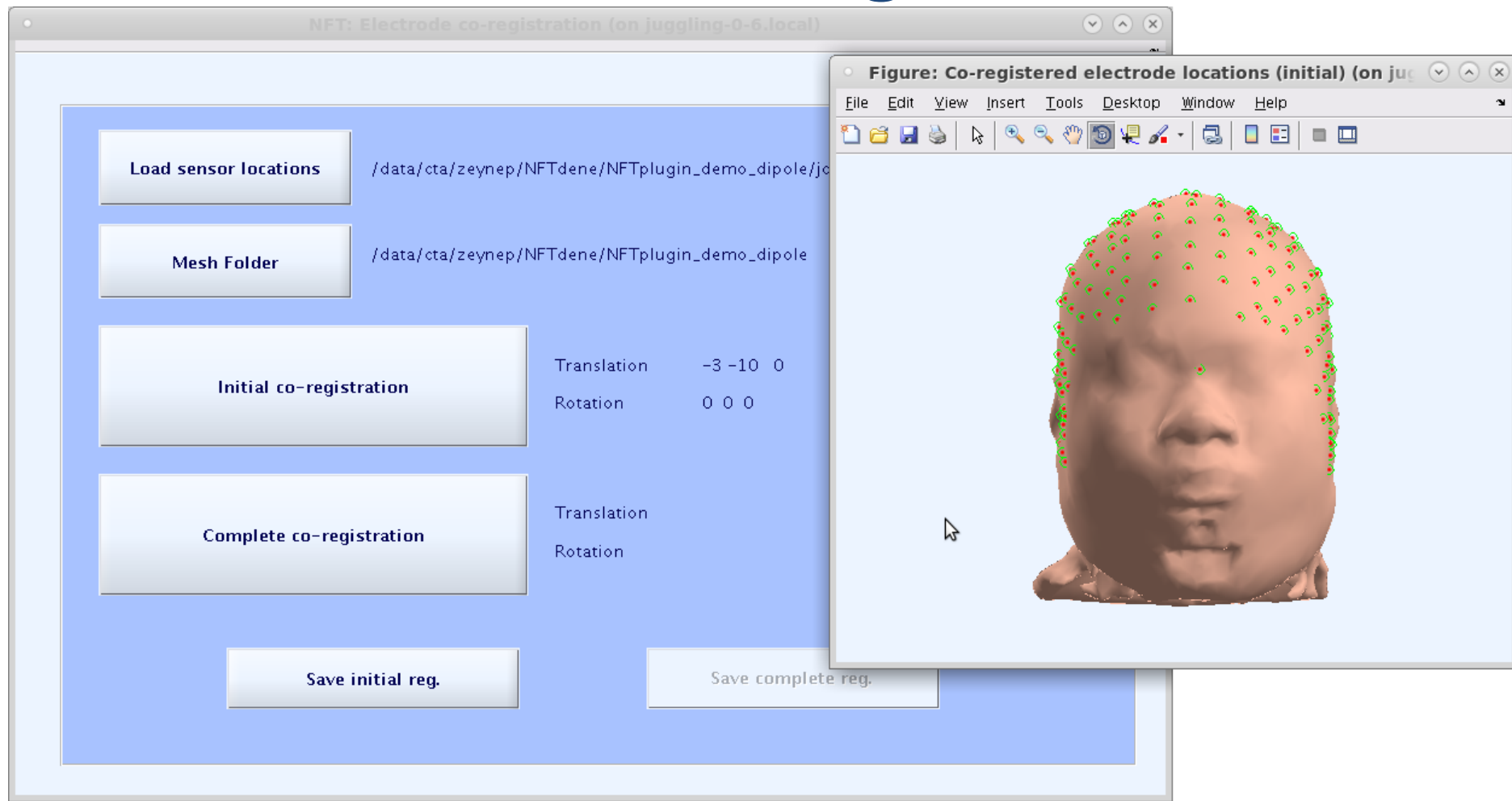
Save initial reg.

Save complete reg.

Electrode Co-registration



Electrode Co-registration



Electrode co-registration

NFT: Electrode co-registration (on juggling-0-6.local)

Load sensor locations /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_fid.sfp

Mesh Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Initial co-registration

Translation -3 -10 0
Rotation 0 0 0

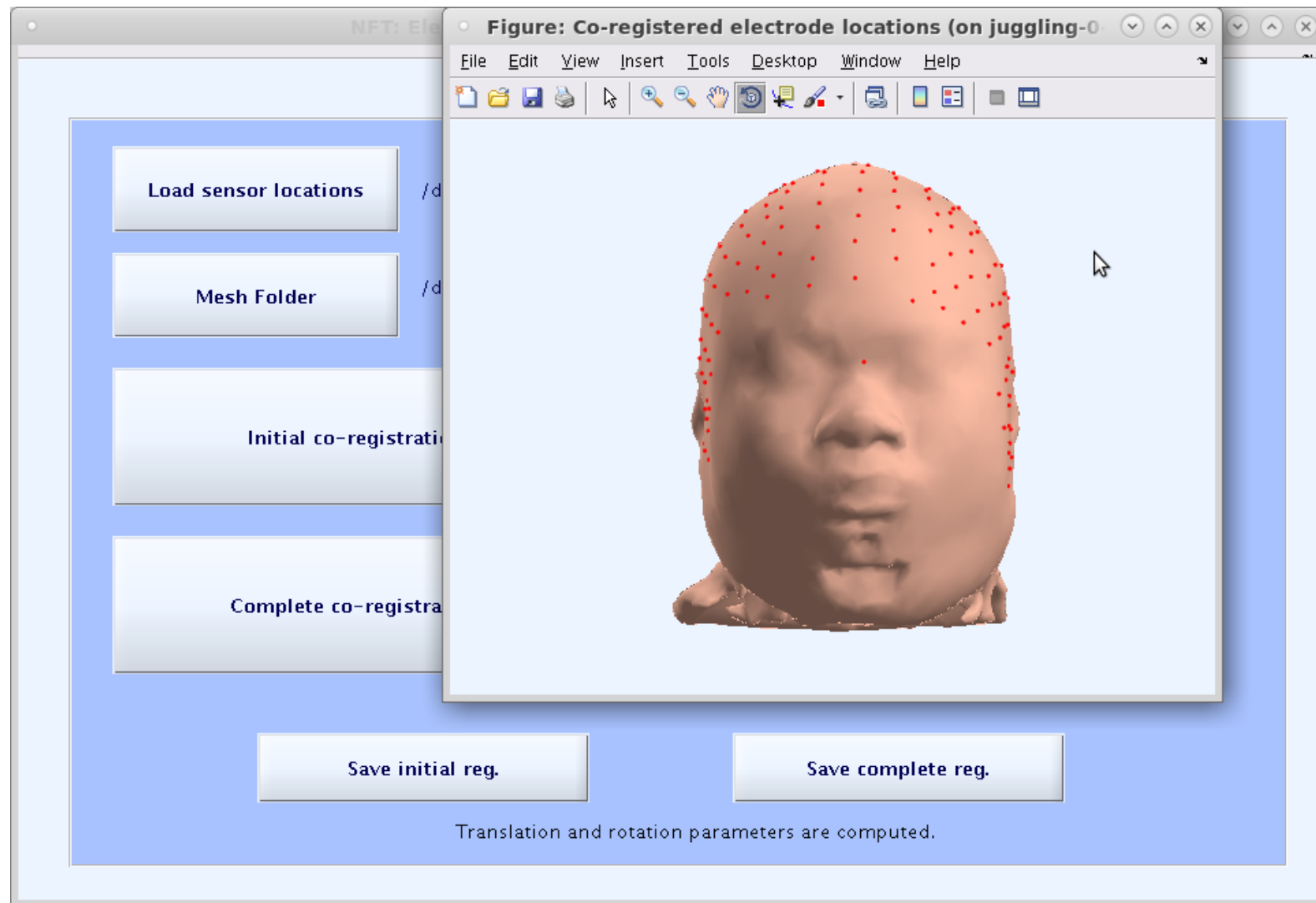
Complete co-registration

Translation
Rotation

Save initial reg. **Save complete reg.**

Computing translation and rotation parameters...

Electrode co-registration



Mesh generation

NFT: Electrode co-registration (on juggling-0-6.local)

Load sensor locations /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole/jc_fid.sfp

Mesh Folder /data/cta/zeynep/NFTdene/NFTplugin_demo_dipole

Initial co-registration

Translation -3 -10 0

Rotation 0 0 0

Complete co-registration

Translation 10.3303 -1.18985 -11.5649

Rotation 1.6886 -3.3001 0.42156

Save initial reg. **Save complete reg.**

Automatic registration is saved.

```
>> sens=load('jc_s1.sensors','-mat')
```

```
sens =
```

```
    fn: '/data/cta/zeynep/NFTdene/JC/jc_fid.sfp'  
  eloc: [1x208 struct]  
   pnt: [208x3 double]  
   ind: [1x208 double]  
 param: [1x1 struct]
```

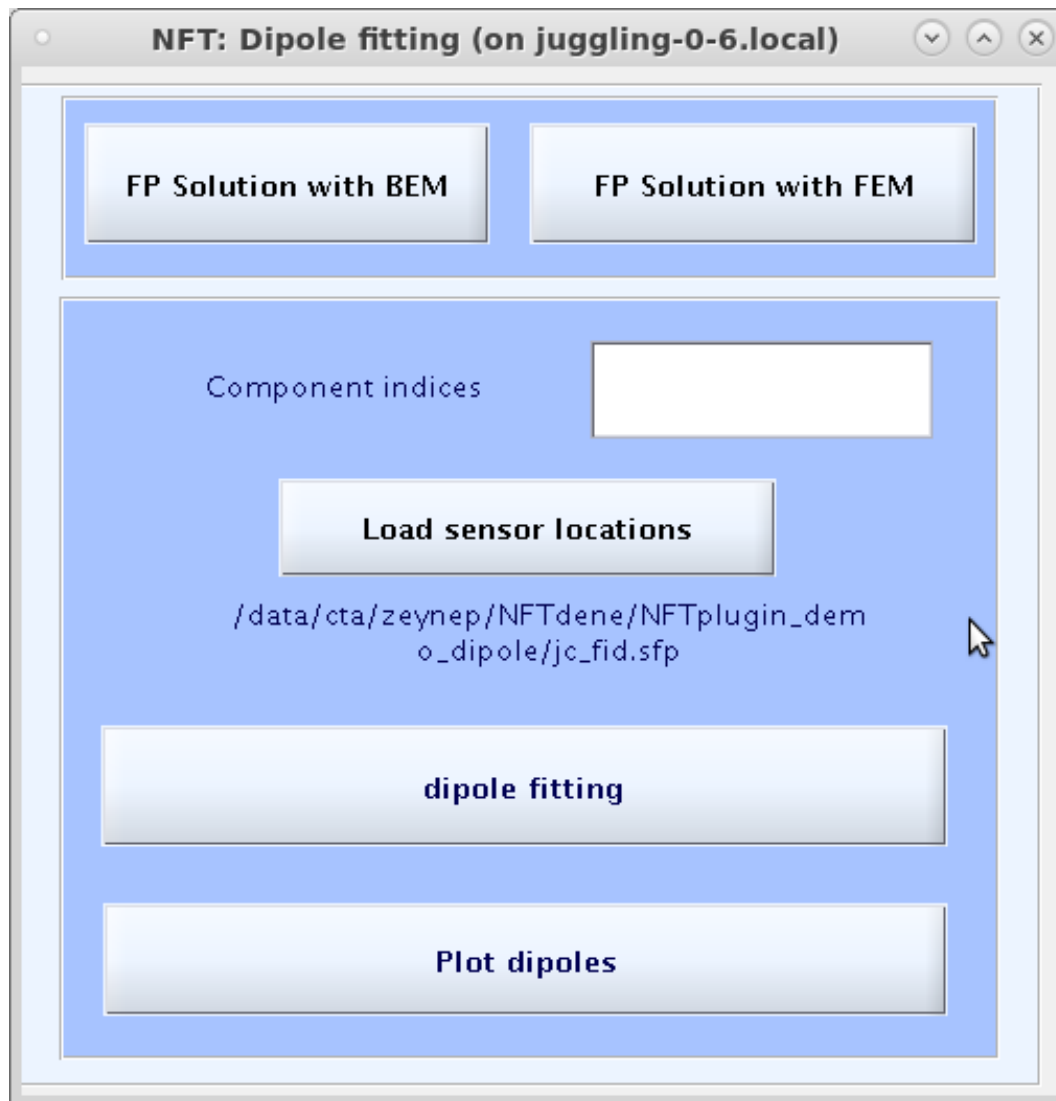
```
>> sens.param
```

```
ans =
```

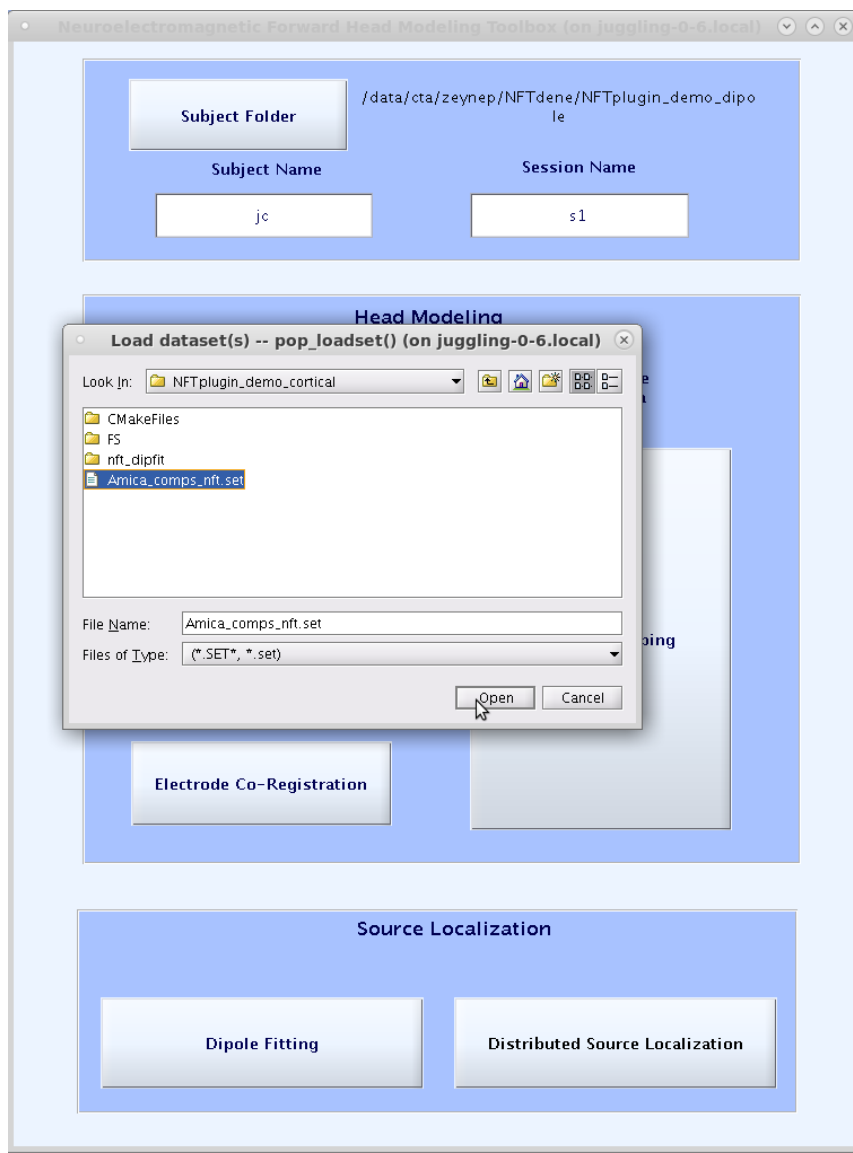
```
  init: [-3 -10 0 0 0 0 1 1 1]  
  auto: [10.3303 -1.1899 -11.5649 1.6886 -3.3001 0.4216]
```

```
>> |
```


Dipole source localization



Select EEG data



Forward Problem Solver

- ◆ MATLAB interface to numerical solvers
- ◆ Boundary Element Method or Finite Element Method
 - EEG Only (for now)
 - Interfaces to the Matrix generator executable written in C++
- ◆ Other computation done in MATLAB
- ◆ Generated matrices are stored on disk for future use.

Forward Problem Solution with BEM

Forward Model Generation

NFT: Forward problem solution (on juggling-0-6.local)

File

BEM Mesh Info

Mesh Name

Number of Layers

Number of Nodes

Number of Elements

Number of Nodes/Element

BEM Model

Model Name

Enter conductivity values:

Scalp Skull

Brain CSF

☒ Modified (Isolated Problem Approach)

Value Changed!

Session

Session Name

Load Sensors

☒ Mesh Coordinates

☐ Mesh Node List

Value Changed!

Forward Problem Solution

For Dipole

Forward Problem Solution with BEM

Forward Model Generation

NFT: Forward problem solution (on juggling-0-6.local)

File

BEM Mesh Info

Mesh Name

Number of Layers

Number of Nodes

Number of Elements

Number of Nodes/Element

BEM Model

Model Name

Enter conductivity values:

Scalp Skull

Brain CSF

☒ Modified (Isolated Problem Approach)

Value Changed!

Session

Session Name

Load Sensors

☒ Mesh Coordinates

☐ Mesh Node List

Value Changed!

Forward Problem Solution

For Dipole

Forward Problem Solution with BEM

Forward Model Generation

NFT: Forward problem solution (on juggling-0-6.local)

BEM Mesh Info

jc

Mesh Name

Show Mesh

4

Number of Layers

16151

Number of Nodes

32286

Number of Elements

3

Number of Nodes/Element

BEM Model

jc

Model Name

Enter conductivity values:

0.33

Scalp

0.0132

Skull

0.33

Brain

1.79

CSF

☒ Modified (Isolated Problem Approach)

Create Model

BEM Model Created

Session

s1

Session Name

Load Sensors

☒ Mesh Coordinates

☐ Mesh Node List

Load

Show Sensors

Generate transfer matrix

Value Changed!

Forward Problem Solution

Load Source Space

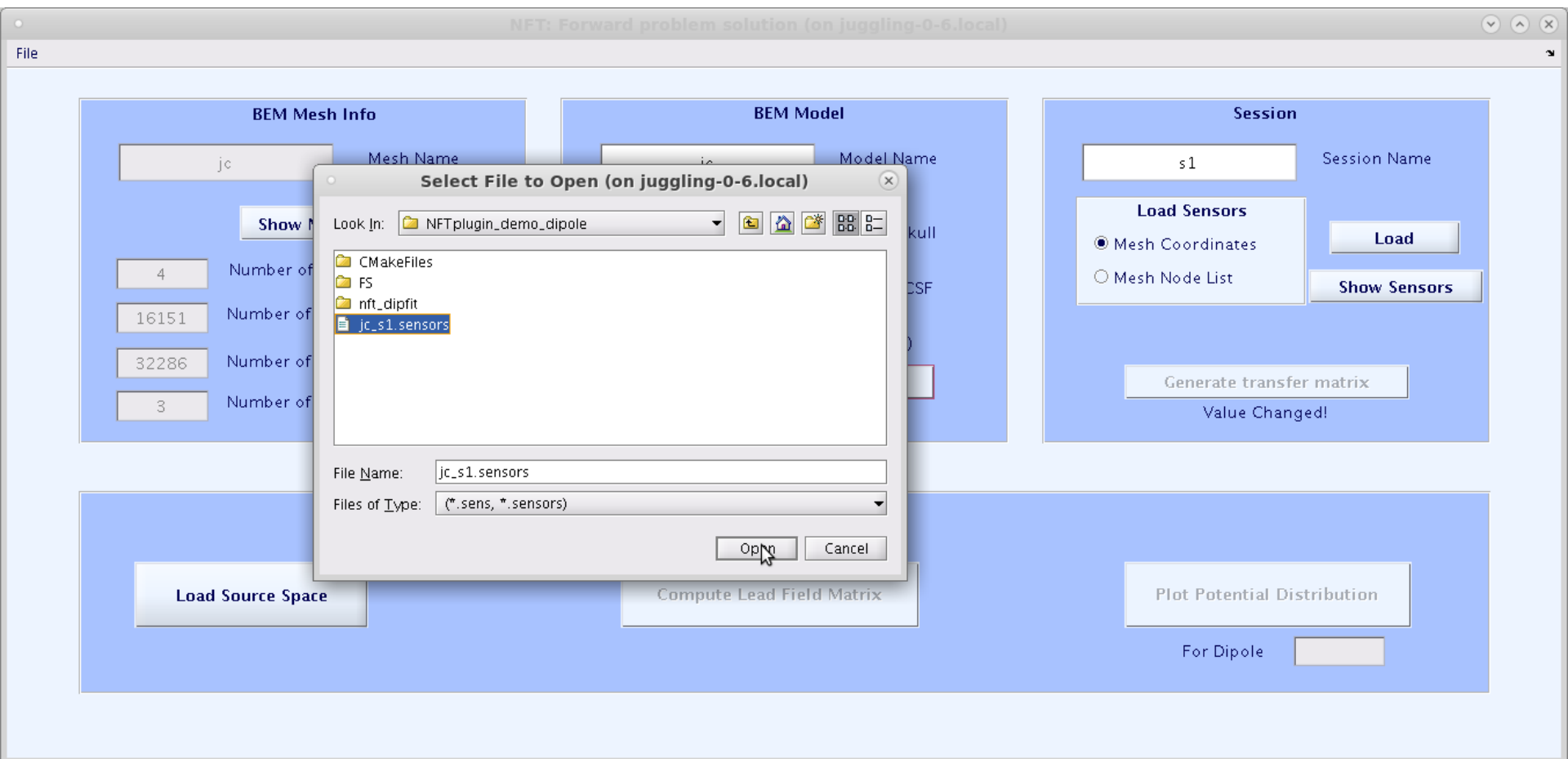
Compute Lead Field Matrix

Plot Potential Distribution

For Dipole

Forward Problem Solution with BEM

Forward Model Generation



Forward Problem Solution with BEM

Forward Model Generation

NFT: Forward problem solution (on juggling-0-6.local)

BEM Mesh Info

jc

Mesh Name

Show Mesh

4

Number of Layers

16151

Number of Nodes

32286

Number of Elements

3

Number of Nodes/Element

BEM Model

jc

Model Name

Enter conductivity values:

0.33

Scalp

0.0132

Skull

0.33

Brain

1.79

CSF

☒ Modified (Isolated Problem Approach)

Create Model

BEM Model Loaded

Session

s1

Session Name

Load Sensors

☒ Mesh Coordinates

☐ Mesh Node List

Load

Show Sensors

208

Sensors Loaded

Generate transfer matrix

Session Loaded

Forward Problem Solution

Load Source Space

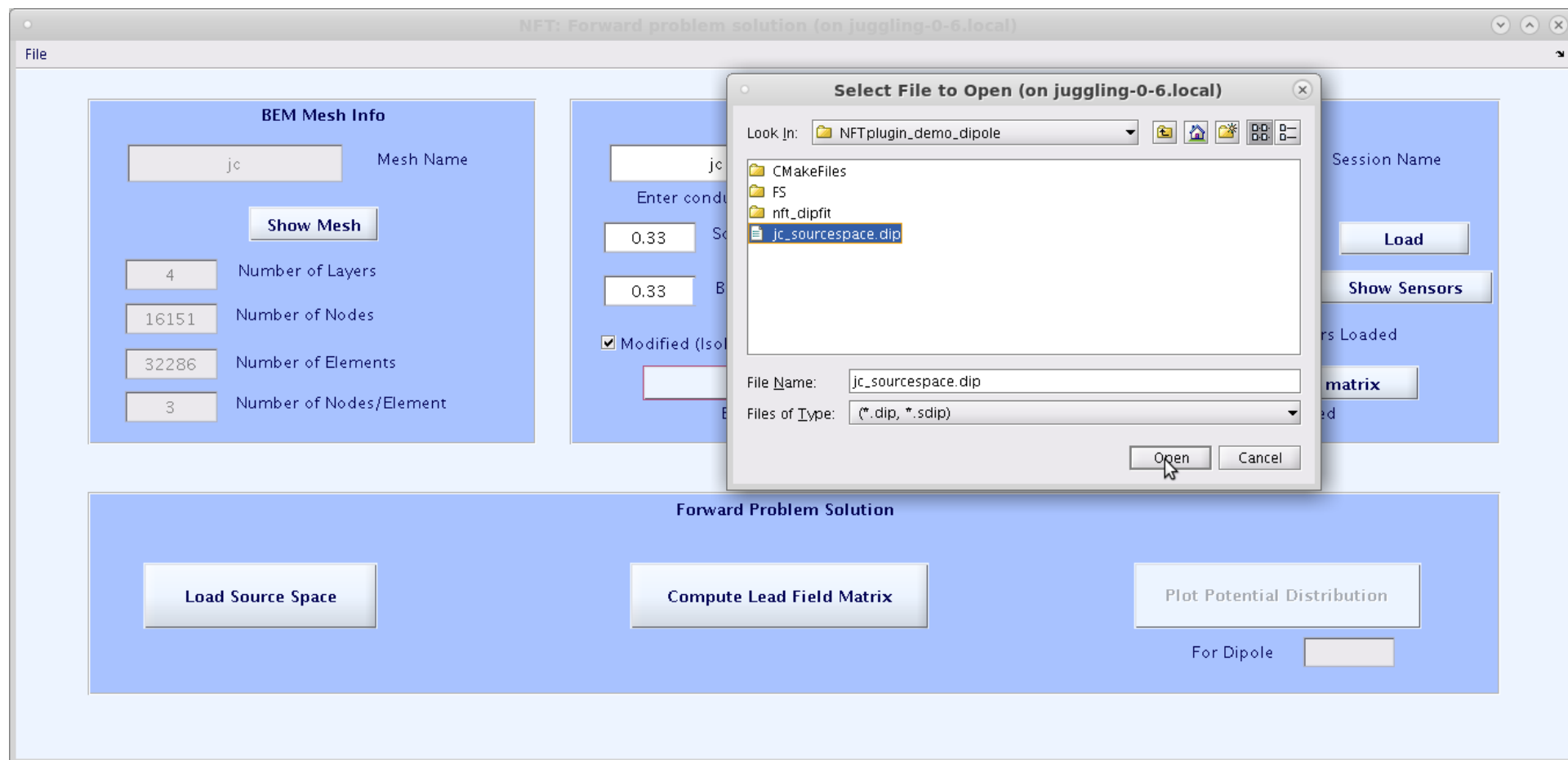
Compute Lead Field Matrix

Plot Potential Distribution

For Dipole

Forward Problem Solution with BEM

Forward Model Generation



Forward Problem Solution with BEM

Forward Model Generation

NFT: Forward problem solution (on juggling-0-6.local)

File

BEM Mesh Info

Mesh Name

Number of Layers

Number of Nodes

Number of Elements

Number of Nodes/Element

BEM Model

Model Name

Enter conductivity values:

Scalp Skull

Brain CSF

☒ Modified (Isolated Problem Approach)

BEM Model Loaded

Session

Session Name

Load Sensors

☒ Mesh Coordinates

☐ Mesh Node List

Sensors Loaded

Session Loaded

Forward Problem Solution

Dipoles Loaded

For Dipole

Forward Problem Solution with BEM

Forward Model Generation

NFT: Forward problem solution (on juggling-0-6.local)

File

BEM Mesh Info

Mesh Name

Number of Layers

Number of Nodes

Number of Elements

Number of Nodes/Element

BEM Model

Model Name

Enter conductivity values:

Scalp Skull

Brain CSF

☒ Modified (Isolated Problem Approach)

BEM Model Loaded

Session

Session Name

Load Sensors

☒ Mesh Coordinates

☐ Mesh Node List

Sensors Loaded

Session Loaded

Forward Problem Solution

Dipoles Loaded

LFM Computed

For Dipole

Forward Problem Solution with BEM

Forward Model Generation

NFT: Forward problem solution (on juggling-0-6.local)

File

BEM Mesh Info

jc Mesh Name

Show Mesh

4 Number of Layers

16151 Number of Nodes

32286 Number of Elements

3 Number of Nodes/Element

BEM Model

jc Model Name

Enter conductivity values:

0.33 Scalp 0.0132 Skull

0.33 Brain 1.79 CSF

☒ Modified (Isolated Problem Approach)

Create Model

BEM Model Loaded

Session

s1 Session Name

Load Sensors

☒ Mesh Coordinates

☐ Mesh Node List

Load

Show Sensors

208 Sensors Loaded

Generate transfer matrix

Session Loaded

Forward Problem Solution

Load Source Space

7479 Dipoles Loaded

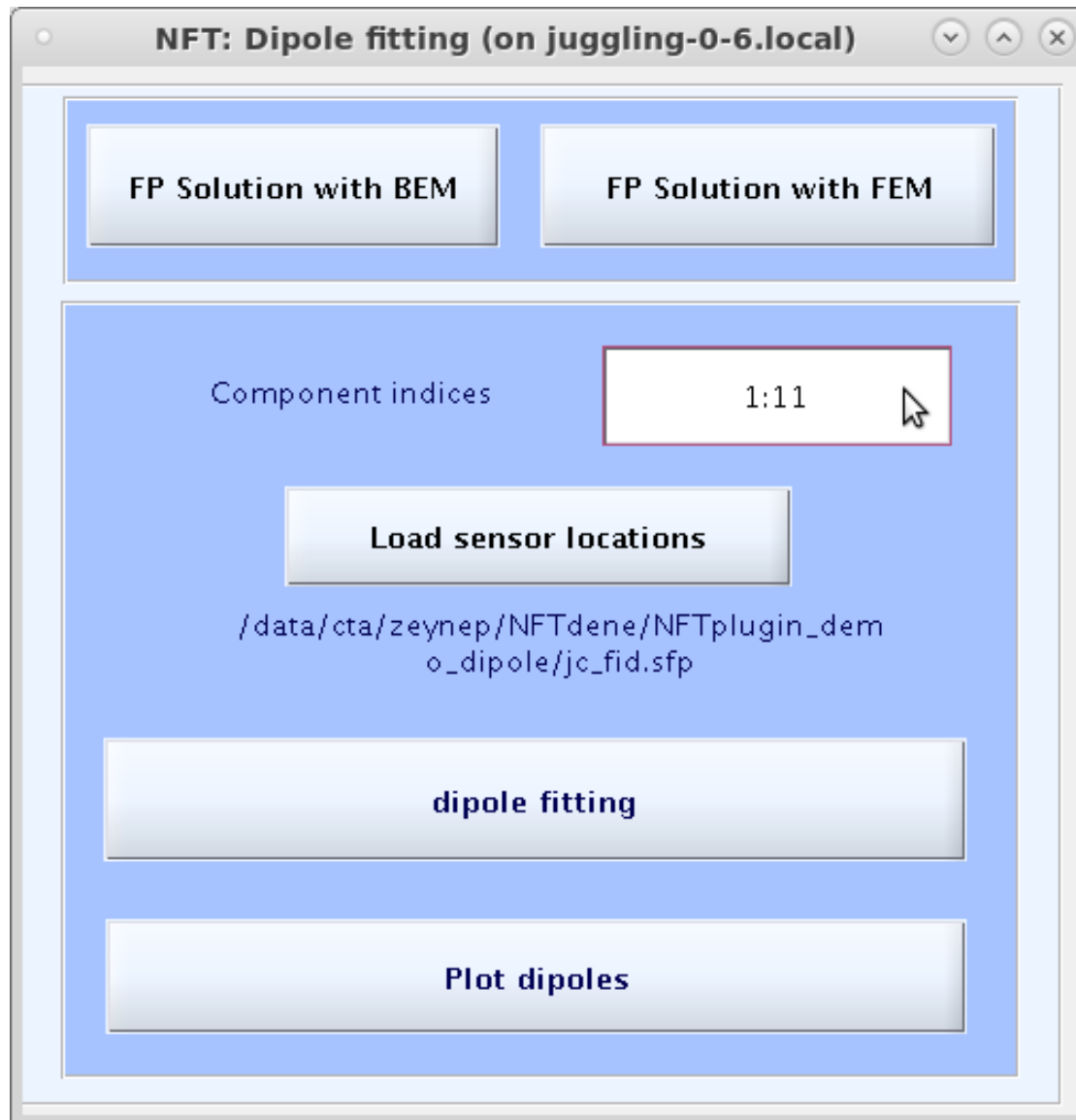
Compute Lead Field Matrix

LFM Computed

Plot Potential Distribution

For Dipole

Inverse Problem Solution with BEM

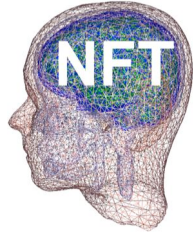


Output

- ◆ Dipole source localization is saved in EEG structure, under EEG.etc.nft.
- ◆ After source localization with NFT, you can continue using EEGLAB;

```
EEG.dipfit.model = EEG.etc.nft.model;
```

Distributed Source localization



Go to the folder NFTplugin_demo_cortical
addpath

Distributed Source Localization

Neuroelectromagnetic Forward Head Modeling Toolbox (on juggling-0-5.local)

Subject Folder: /data/cta/zeynep/NFTdene/NFTplugin_demo_cortical

Subject Name: jc Session Name: s11

Head Modeling

From a magnetic Resonance Image From electrode Position Data

Image Segmentation

Mesh Generation

Source Space Generation

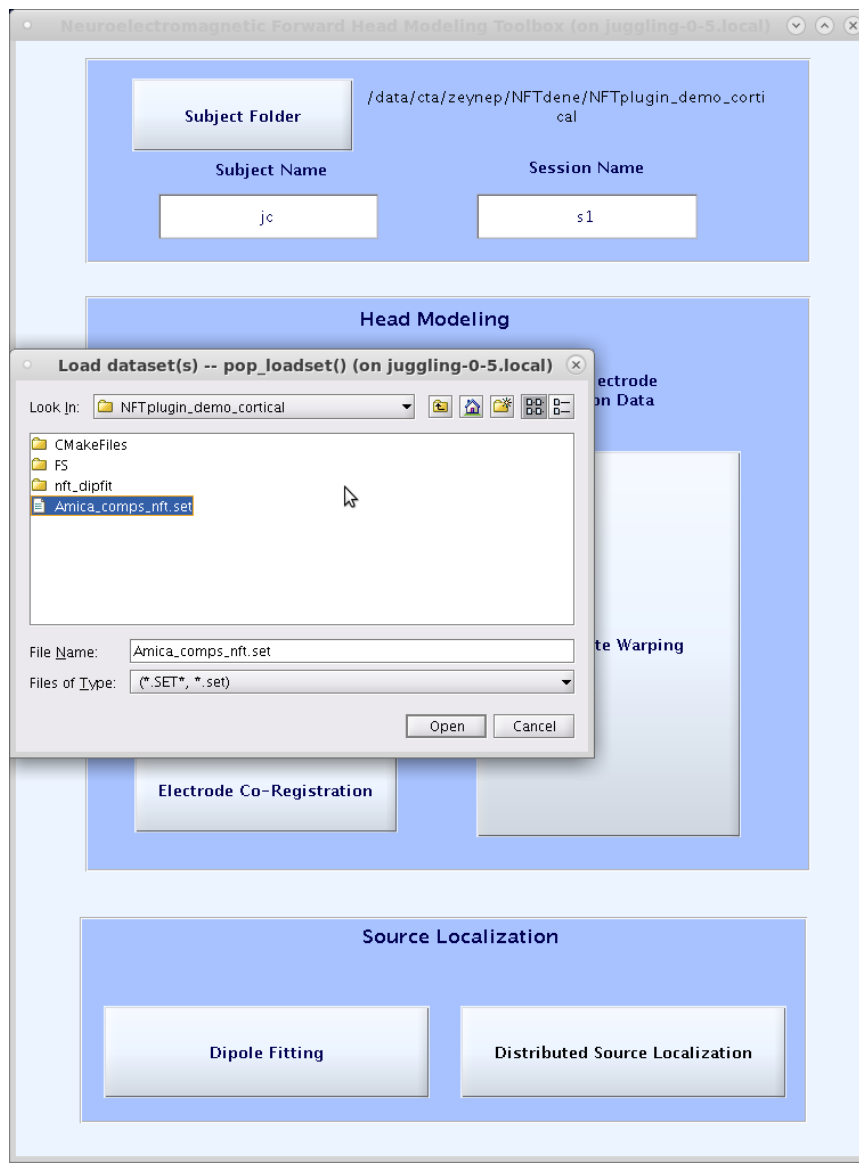
Electrode Co-Registration

Template Warping

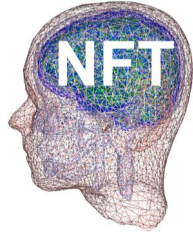
Source Localization

Dipole Fitting Distributed Source Localization

Select EEG data



NIST – Generation of a cortical source space



- ◆ Load Freesurface cortical surface
- ◆ Downsample to 80,000 vertices
- ◆ Co-register with the NFT brain surface
- ◆ Re-generate NFT head model
- ◆ Calculate normals for each vertex on the cortical surface
- ◆ Save the cortical source space as: **Subject_name FS_ss.dip**
- ◆ Calculate node area of each vertex for source localization, save as **Node_area**
- ◆ Check if the sensor locations need to be updated according to the new NFT model.

Distributed Source Localization

Distributed_Source_Localization (on juggling-0-5.local)

Load MRI MRI file

Start Freesurfer

Cortical source space 80000 10 mm Generate patches

of dipoles in source space

Forward Problem Solution

FP Solution with BEM FP Solution with FEM

Cortical Source Localization

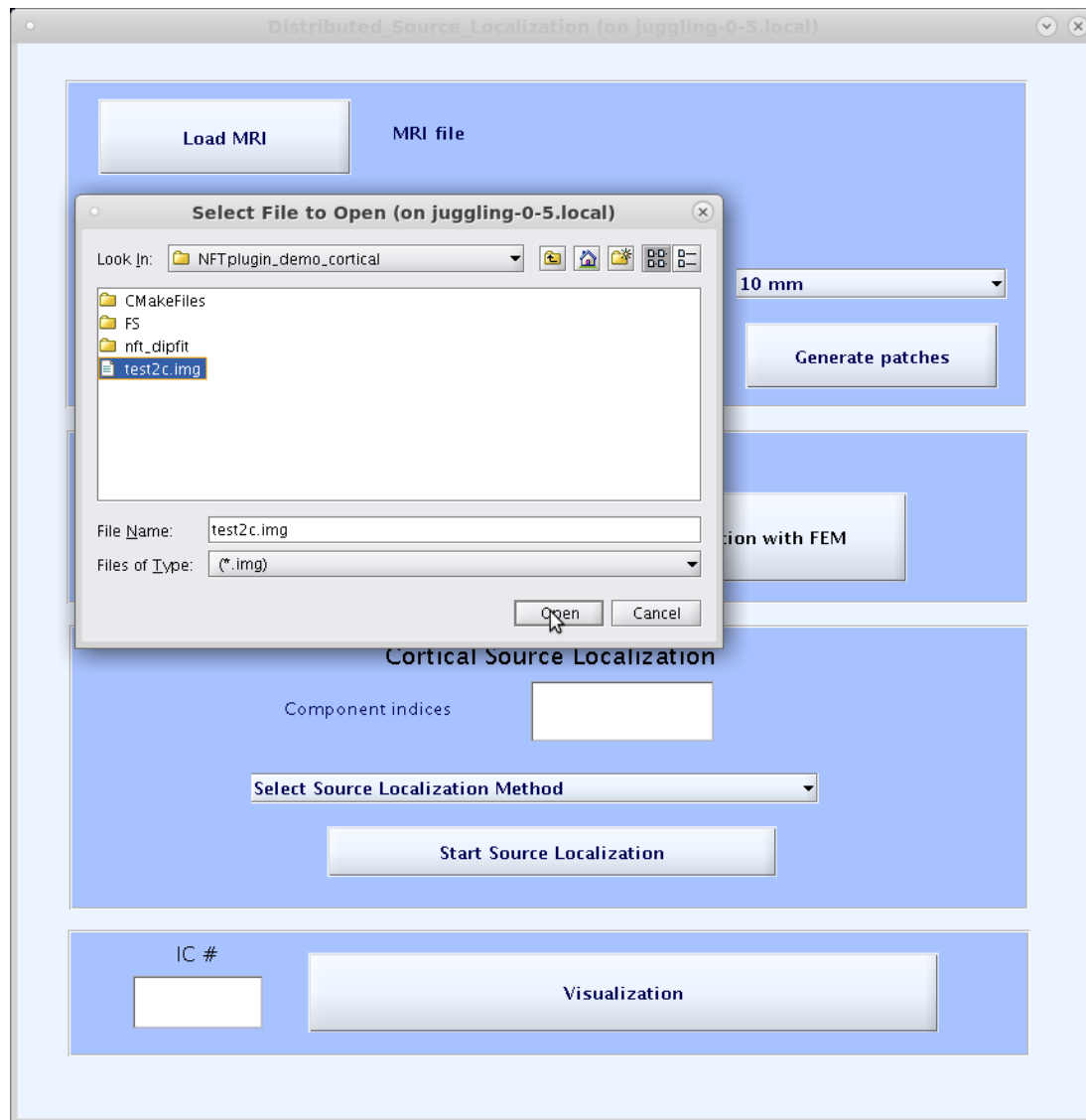
Component indices

Select Source Localization Method

Start Source Localization

IC # Visualization

Load MRI



Run Freesurfer

Distributed_Source_Localization (on juggling-0-5.local)

Load MRI

Start Freesurfer

Cortical source space # of dipoles in source space

10 mm

Generate patches

Forward Problem Solution

FP Solution with BEM

FP Solution with FEM

Cortical Source Localization

Component indices

Select Source Localization Method

Start Source Localization

IC #

Visualization

Distributed Source Localization (on juggling-0-5.local)

Load MRI /data/cta/zeynep/NFTdene/NFTplugin_demo_cortical/test2c.img

Start Freesurfer Running Freesurfer completed!

Cortical source space 10 mm

80000 # of dipoles in source space Generate patches

Forward Problem Solution

FP Solution with BEM FP Solution with FEM

Cortical Source Localization

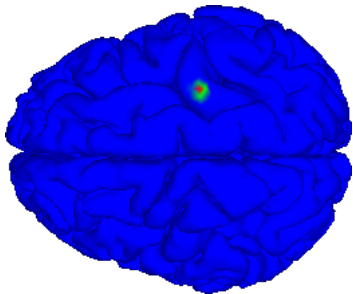
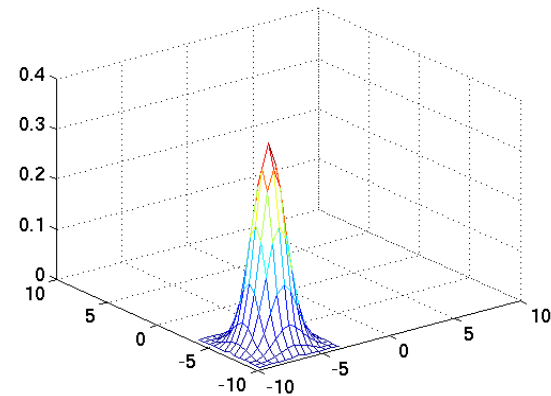
Component indices

Select Source Localization Method ▼

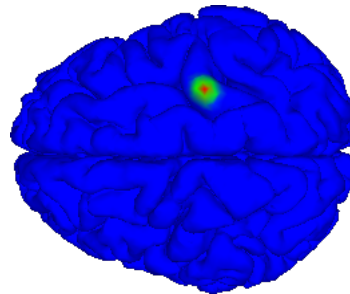
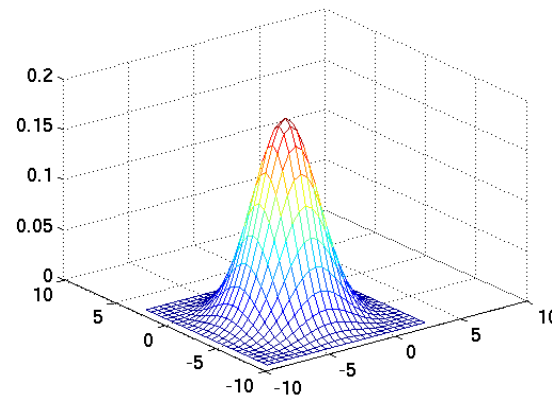
Start Source Localization

IC # Visualization

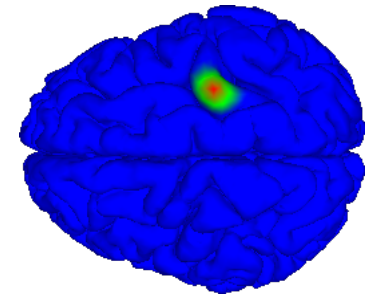
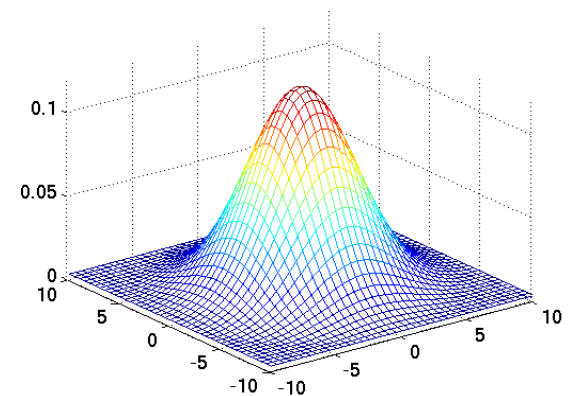
NIST – Patch generation



3 mm patch

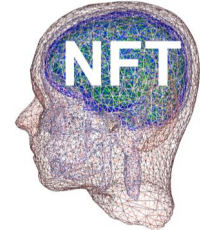


6 mm patch



10 mm patch

NIST has options to generate Gaussian patches with 10 mm, 6 mm, 3 mm in radius.



Load MRI

/data/cta/zeynep/NFTdene/NFTplugin_demo_cortical/test2c.img

Start Freesurfer

Running Freesurfer completed!

Cortical source space

80000

of dipoles in source space

3,6,10 mm

Generate patches

Forward Problem Solution

FP Solution with BEM

FP Solution with FEM

Cortical Source Localization

Component indices

Select Source Localization Method

Start Source Localization

IC #

Visualization

Forward Problem Solution with FEM

- ◆ Tetgen for mesh generation
 - Uses BEM meshes as boundaries
- ◆ METU-FEM to generate transfer matrix
 - Compiled from source
 - Requires PETSc for matrix operations
- ◆ metufem .mex file for forward solutions in MATLAB
- ◆ Instructions available under README.FEM file.

File

Select File to Open (on juggling-0-5.local)

Look In: NFTplugin_demo_cortical



- CMaFiles
- FS
- nft_dipfit
- jc.1.msh
- jcFS.1.msh**

File Name: jcFS.1.msh

Files of Type: (*.msh)

Open

Cancel

FEM Session

jcFS

Session Name

for conductivity values:

Scalp

0.0132

Skull

Brain

Sensors

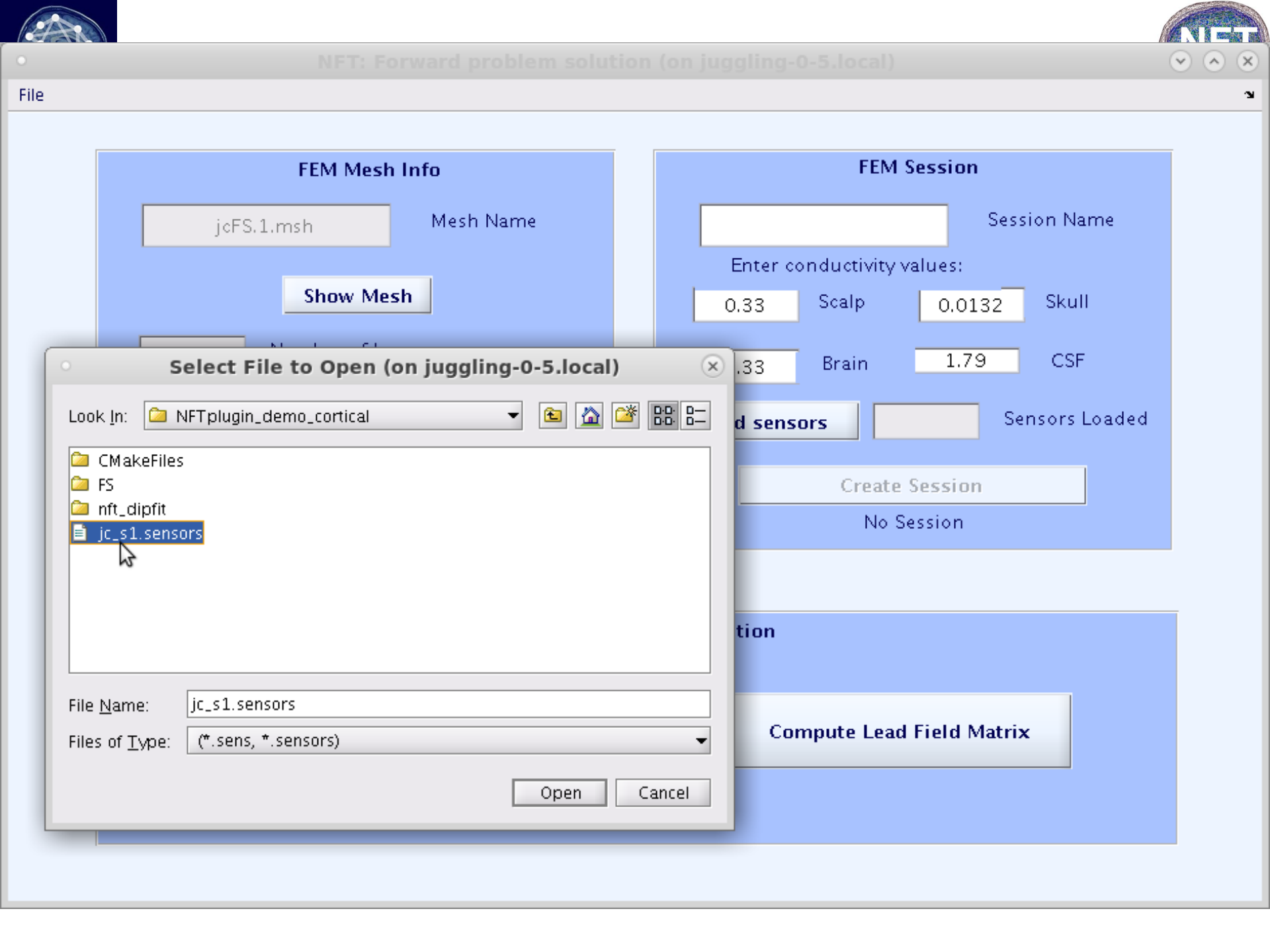
Sensors Loaded

Create Session

Value Changed!

Load Source Space

Compute Lead Field Matrix



FEM Mesh Info

jcFS.1.msh

Mesh Name

Show Mesh

FEM Session

Session Name

Enter conductivity values:

0.33

Scalp

0.0132

Skull

0.33

Brain

1.79

CSF

Load sensors

Sensors Loaded

Create Session

No Session

tion

Compute Lead Field Matrix

Select File to Open (on juggling-0-5.local)

Look In: NFTplugin_demo_cortical

- CMakeFiles
- FS
- nft_dipfit
- jc_s1.sensors

File Name: jc_s1.sensors

Files of Type: (*.sens, *.sensors)

Open

Cancel



FEM Mesh Info

jcFS.1.msh

Mesh Name

Show Mesh

4

Number of Layers

297956

Number of Nodes

4

Number of Nodes/Element

FEM Session

s1

Session Name

Enter conductivity values:

0.33

Scalp

0.0132

Skull

0.33

Brain

1.79

CSF

Load sensors

208

Sensors Loaded

Create Session

Value Changed!

Forward Problem Solution

Load Source Space

Compute Lead Field Matrix

File

Select File to Open (on juggling-0-5.local)

Look In: 📁 NFTplugin_demo_cortical



- 📁 CMakeFiles
- 📁 FS
- 📁 nft_dipfit
- 📄 jc_sourcespace.dip
- 📄 **jcFS_ss.dip**

File Name:

Files of Type: (*.dip)

Open

Cancel

FEM Session

s1

Session Name

conductivity values:

Scalp

0.0132

Skull

Brain

1.79

CSF

Sensors

208

Sensors Loaded

Create Session

FEM Session Created

Forward Problem Solution

Load Source Space

Compute Lead Field Matrix



FEM Mesh Info

jcFS.1.msh

Mesh Name

Show Mesh

4

Number of Layers

297956

Number of Nodes

4

Number of Nodes/Element

FEM Session

s1

Session Name

Enter conductivity values:

0.33

Scalp

0.0132

Skull

0.33

Brain

1.79

CSF

Load sensors

208

Sensors Loaded

Create Session

FEM Session Created

Forward Problem Solution

Load Source Space

80150

Dipoles Loaded

Compute Lead Field Matrix

FEM Mesh Info

jcFS.1.msh

Mesh Name

Show Mesh

4

Number of Layers

297956

Number of Nodes

4

Number of Nodes/Element

FEM Session

s1

Session Name

Enter conductivity values:

0.33

Scalp

0.0132

Skull

0.33

Brain

1.79

CSF

Load sensors

208

Sensors Loaded

Create Session

FEM Session Loaded

Forward Problem Solution

Load Source Space

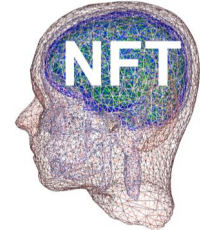
80150

Dipoles Loaded

Compute Lead Field Matrix



LFM Computed



Load MRI

/data/cta/zeynep/NFTdene/NFTplugin_demo_cortical/test2c.img

Start Freesurfer

Running Freesurfer completed!

Cortical source space

80000

of dipoles in source space

3,6,10 mm

Generate patches

Forward Problem Solution

FP Solution with BEM

FP Solution with FEM

Cortical Source Localization

Component indices

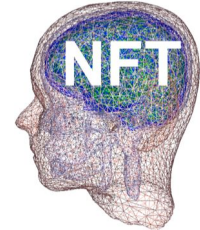
1:11

Select Source Localization Method

Start Source Localization

IC #

Visualization



Load MRI

/data/cta/zeynep/NFTdene/NFTplugin_demo_cortical/test2c.img

Start Freesurfer

Running Freesurfer completed!

Cortical source space

80000

of dipoles in source space

3,6,10 mm

Generate patches

Forward Problem Solution

FP Solution with BEM

FP Solution with FEM

Cortical Source Localization

Component indices

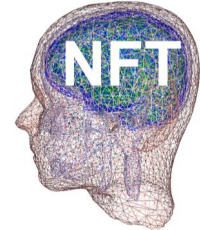
1:11

Sparse compact and smooth (SCS) method

Start Source Localization

IC #

Visualization



Load MRI

/data/cta/zeynep/NFTdene/NFTplugin_demo_cortical/test2c.img

Start Freesurfer

Running Freesurfer completed!

Cortical source space

80000

of dipoles in source space

3,6,10 mm

Generate patches

Forward Problem Solution

FP Solution with BEM

FP Solution with FEM

Cortical Source Localization

Component indices

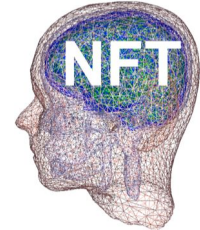
1:11

Sparse compact and smooth (SCS) method

Start Source Localization

IC #

Visualization



Load MRI

/data/cta/zeynep/NFTdene/NFTplugin_demo_cortical/test2c.img

Start Freesurfer

Running Freesurfer completed!

Cortical source space

80000

of dipoles in source space

3,6,10 mm

Generate patches

Forward Problem Solution

FP Solution with BEM

FP Solution with FEM

Cortical Source Localization

Component indices

1:11

Sparse compact and smooth (SCS) method

Start Source Localization

IC #

21

Visualization

Output

- ◆ Source estimates are saved as `cortex_source_scs` and/or `cortex_source_sbl`

Child Head modeling

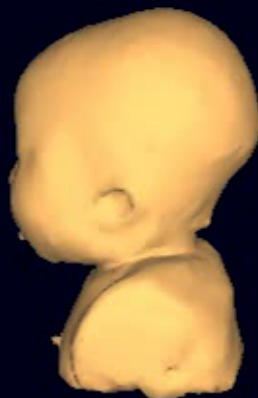
- ◆ Segmentation of infant/child head into scalp, skull, CSF, and brain tissues.
- ◆ Electrical head mesh generation using NFT, making possible
- ◆ Non-invasive conductivity estimation of major head tissues, and also
- ◆ Making available accurate, age-specific developmental template head models

Generation of individual head models

NFT (sccn.ucsd.edu/nft/) was used to generate four-layer Finite Element (FEM) head models.

6 months

12 months



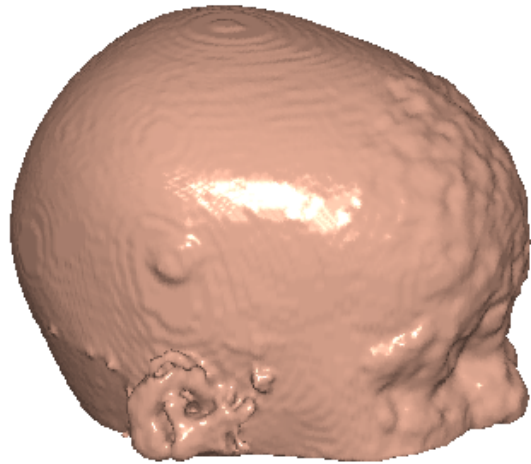
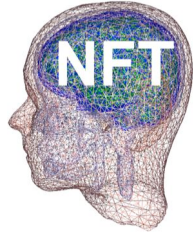
1,441,777

tetrahedral volume
elements

1,025,643

tetrahedral volume
elements

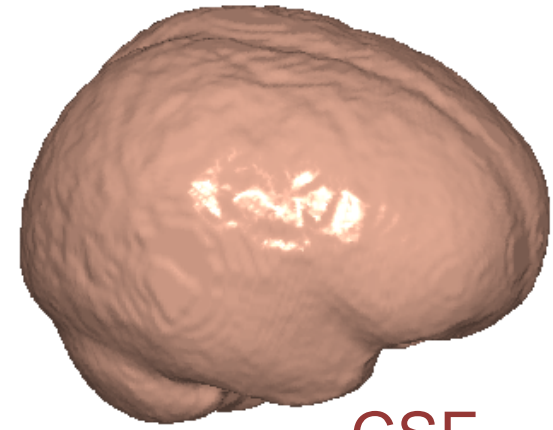
Richards Database for child head modeling



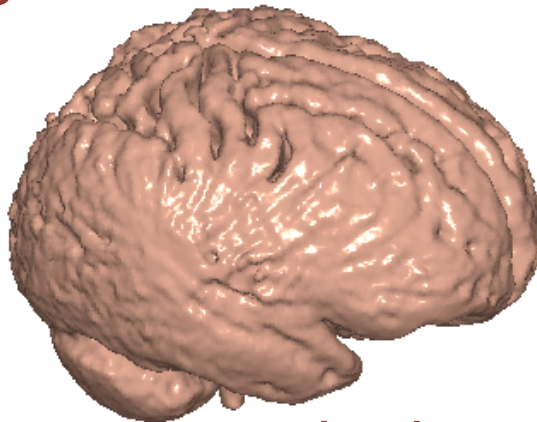
scalp



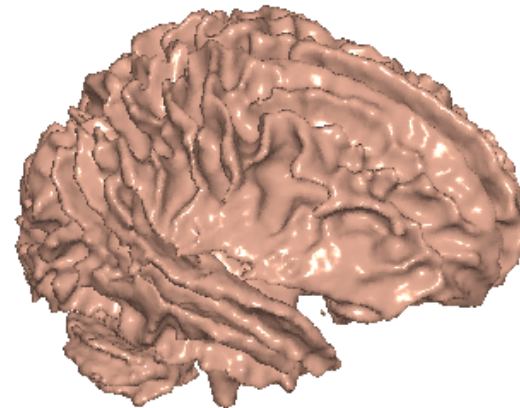
skull



CSF



brain

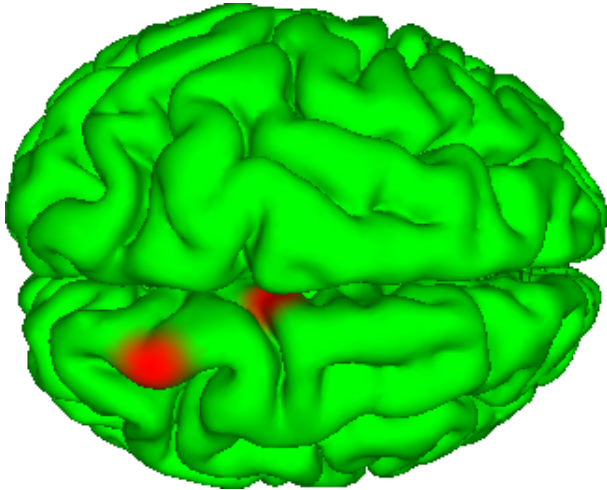


white matter

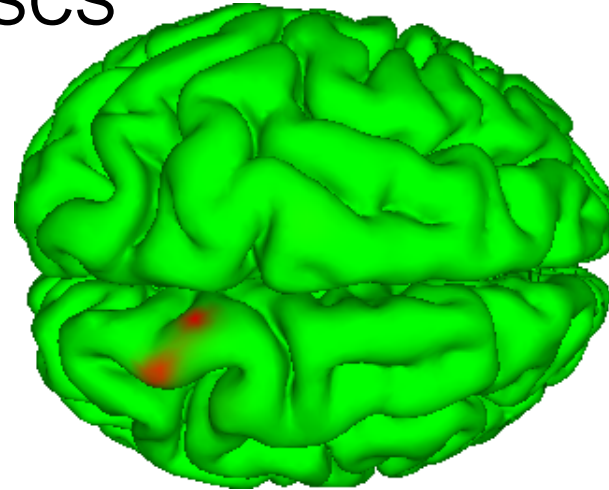
5-layer template BEM head model for three-year olds.

Source localization results

source

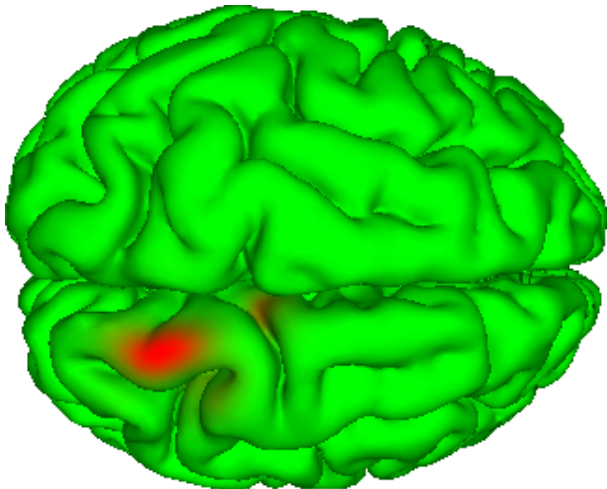


SCS

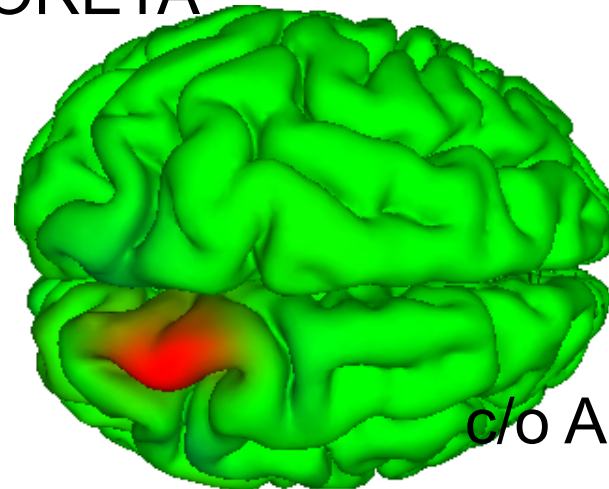


Cheng Cao, 2012

Patch-based SBL

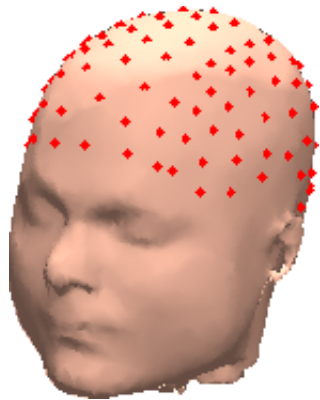


sLORETA



c/o A. Ojeda

EEG source localization



scalp



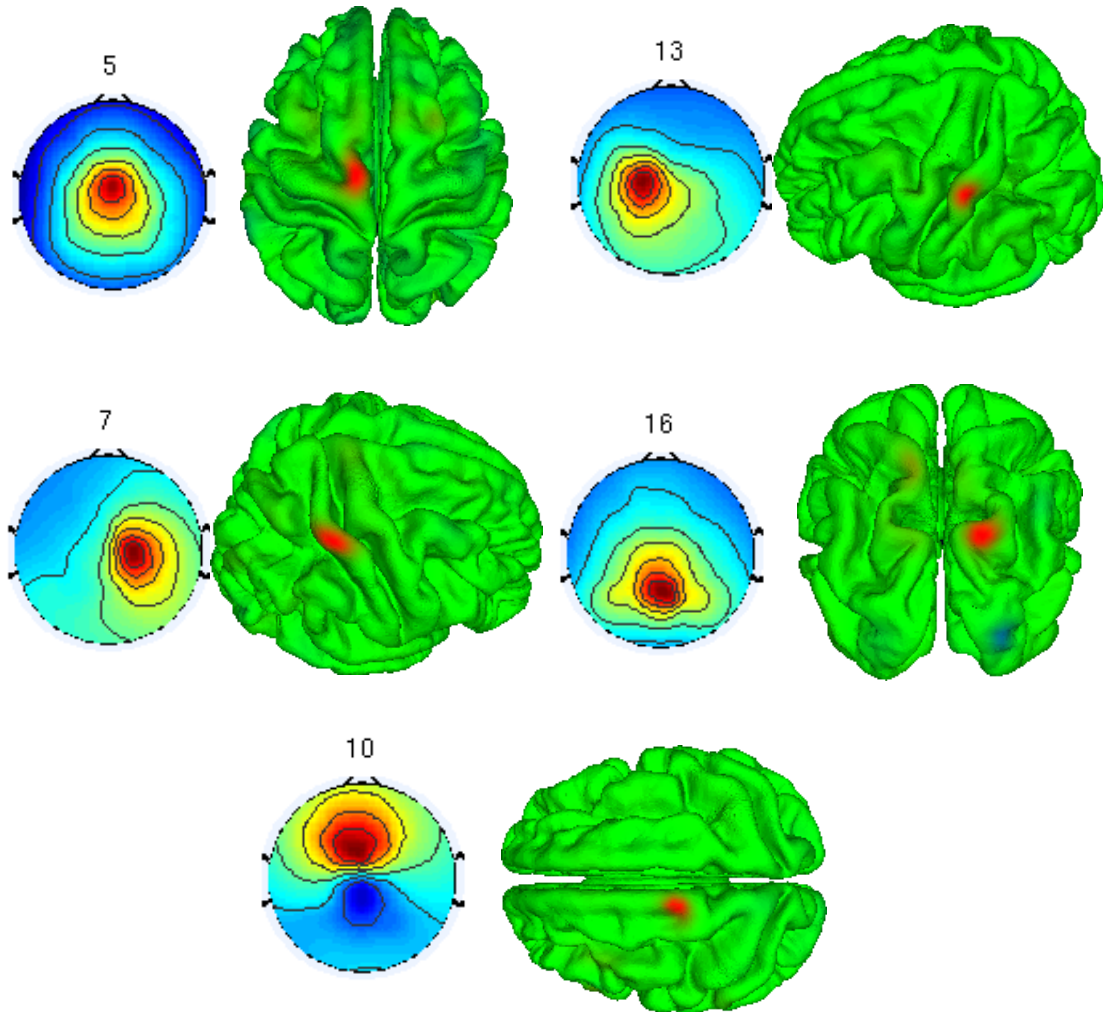
skull



CSF

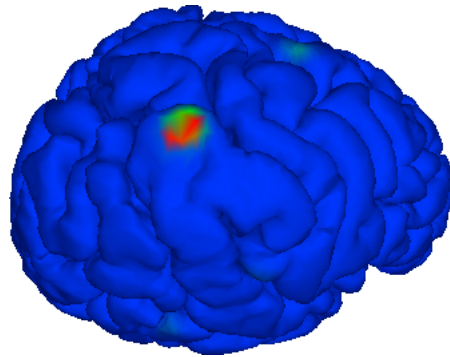
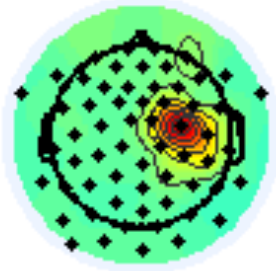


brain

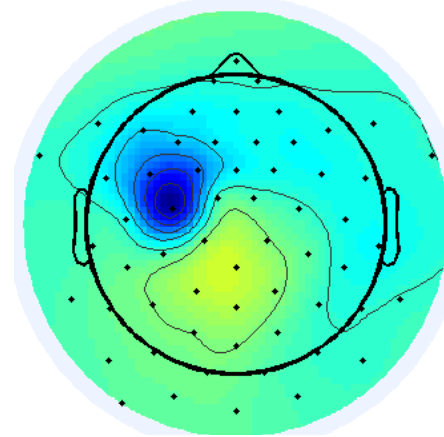


Source localization for 1-year old

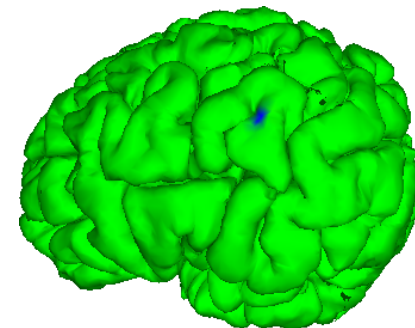
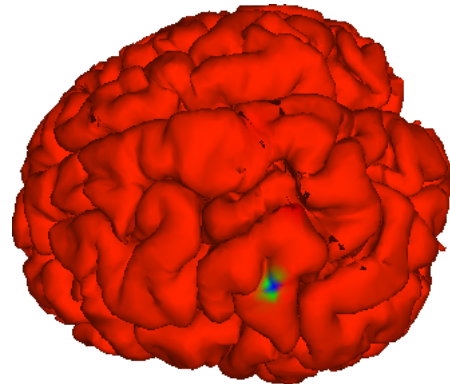
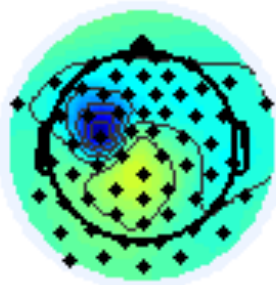
44



IC 22 from SFIC R136.12 epochs



22



Visualization

- ◆ NIST uses Showmesh for visualization of potentials on the cortical surface.
- ◆ Showmesh loads a mesh in .smf format,
- ◆ Loads potential distribution.
- ◆ There are options to load a point set, zoom in, out, rotate, take snapshots.

SHOWMESH TUTORIAL

NFT Matlab Scripts

- ◆ Start EEGLAB and set your parameters:

```
eeglab
```

```
EEG = pop_loadset('filename',eeg_file,'filepath',eeg_path);
```

```
[ALLEEG, EEG, CURRENTSET] = eeg_store( ALLEEG, EEG, 0 );
```

```
% set 'of' (output folder), subject_name,
```

```
% session_name, and elec_file
```

```
subject_name = 'SubjectA';
```

```
session_name = 's1';
```

```
nl = 4; % number of layers
```

```
plotting = 1;
```

```
comp_index = 1:20; % component index for source  
localization
```

NFT Matlab Scripts

◆ Realistic modeling from MRI

% Do segmentation using the GUI

```
nft_mesh_generation(subject_name, of, nl)
```

```
nft_source_space_generation(subject_name, of)
```

% Do co-registration using the GUI

```
nft_forward_problem_solution(subject_name,  
    session_name, of);
```

```
dip1 = nft_inverse_problem_solution(subject_name,  
    session_name, of, EEG, comp_index, plotting,  
    elec_file)
```

NFT Matlab Scripts

- ◆ BEM warping mesh

```
nft_warping_mesh(subject_name, session_name,  
elec_file, nl, of, 0, 0);
```

```
nft_forward_problem_solution(subject_name,  
session_name, of);
```

```
dip1 = nft_inverse_problem_solution(subject_name,  
session_name, of, EEG, comp_index, plotting,  
elec_file)
```


NFT Matlab Scripts

- ◆ FEM warping mesh

```
session_name='s1_fem';
```

```
nft_warping_mesh(subject_name, session_name,  
elec_file, nl, of, 0, 1);
```

```
nft_fem_forward_problem_solution(subject_name,  
session_name, of);
```

```
dip1 = nft_inverse_problem_solution(subject_name,  
session_name, of, EEG, comp_index, plotting,  
elec_file)
```


NFT Matlab Scripts

- ◆ Set NFT dipole structure to EEGLAB dipole structure

```
eeglab_folder = dirname(which('eeglab'));  
mri_file = [eeglab_folder  
            '/plugins/dipfit2.2/standard_BEM/standard_mri.m  
            at'];  
  
EEG.dipfit.mrifile = mri_file;  
EEG.dipfit.model = EEG.etc.nft.model;
```

NFT download and reference

- ◆ <http://www.sccn.ucsd.edu/nft>
- ◆ Akalin Acar Z, Makeig S, Neuroelectromagnetic Forward Head Modeling Toolbox, J. of Neuroscience Methods, vol 190(2), 258-270, 2010.