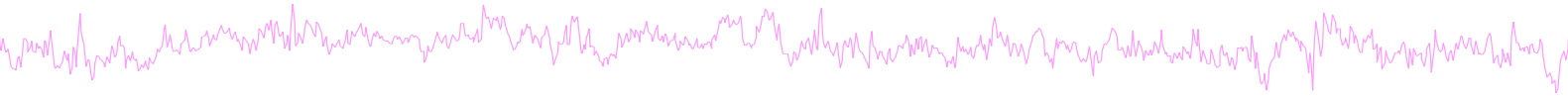
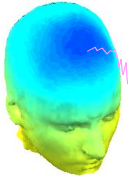
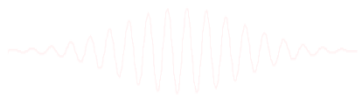


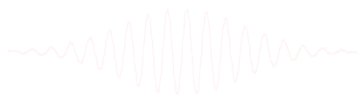
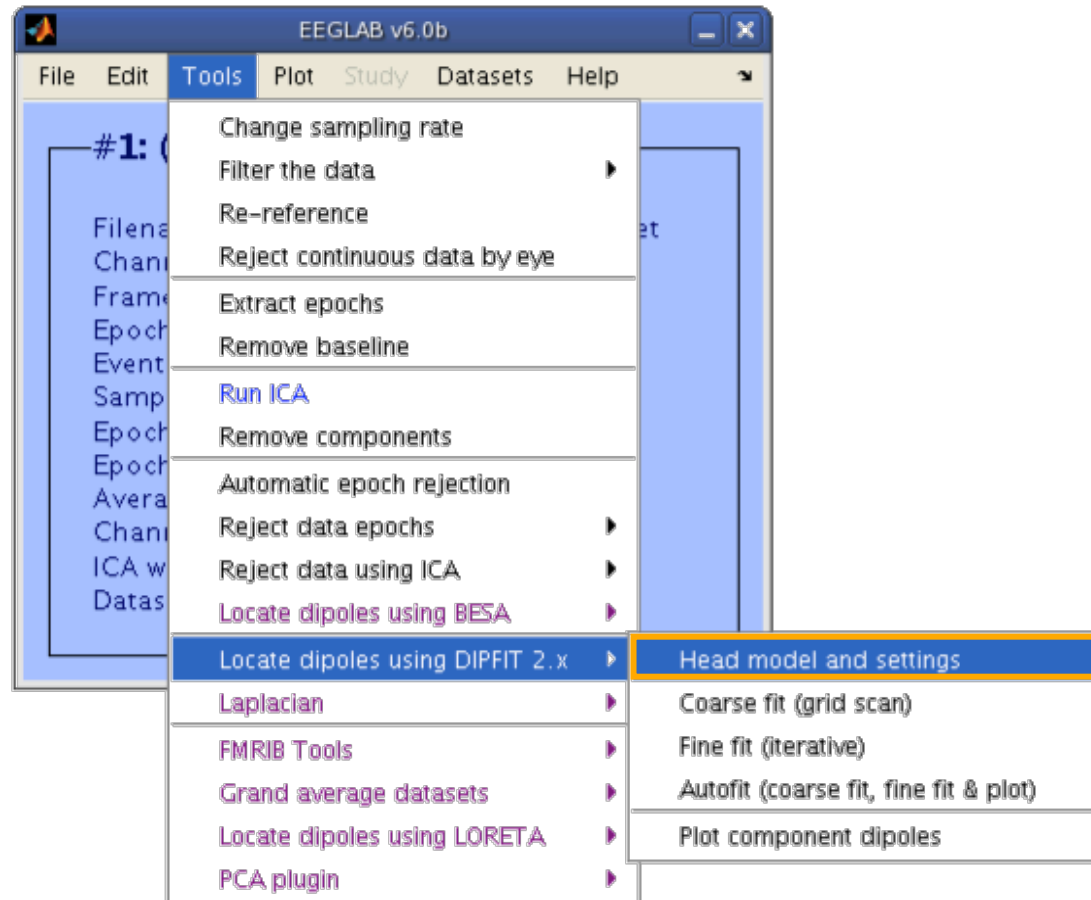
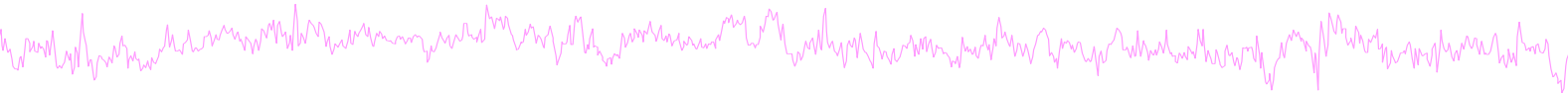
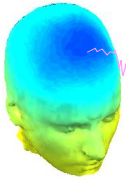
DIPFIT and model co-registration



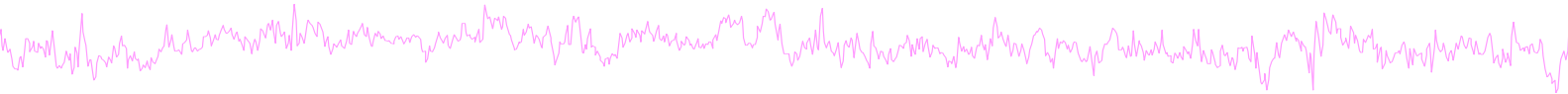
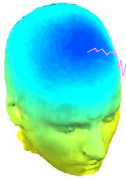
1. Co-register electrodes with model
2. Autofit, plot dipoles, fine fit
3. 3D headplot co-registration



Finding dipole locations using DIPFIT in EEGLAB



Co-register to model



Dipole fit settings - pop_dipfit_settings()

Head model (click to select) Spherical Four-Shell (BESA)
Boundary Element Model (MNI)
CTF MEG
Custom model files

Head model file g:\lab\plugins\dipfit2.2\standard_BEM\standard_vol.mat Browse Help

Output coordinates MNI Click to select

MRI file g:\lab\plugins\dipfit2.2\standard_BEM\standard_mri.mat Browse Help

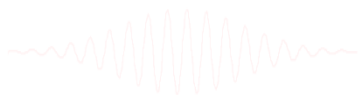
Model template channel locations file g:\lab\plugins\dipfit2.2\standard_BEM\elec\standard_1005.elc Browse Help

Co-register chan. locs. with head model Manual Co-Reg. No Co-Reg.

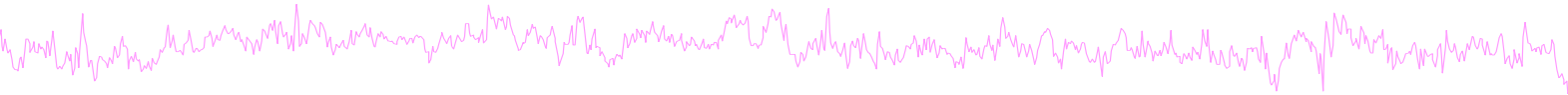
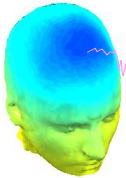
Channels to omit from dipole fitting List

Note: For EEG, check that the channel locations are on the surface of the head model
(To do this: 'Set head radius' to about 85 in the channel editor).

Cancel Help Ok



Alternatively, warp to standard montage



coregister()

File Edit View Insert Tools Desktop Window Help

Labels off
Electrodes
Labels on
Electrodes
Mesh off

Move right (mm) 0 Pitch (rad) 0 Resize (x) 99.05 Align fiducials
Move front (mm) 0 Roll (rad) 0 Resize (y) 99.05 Warp montage
Move up (mm) 0 Yaw (rad) 0 Resize (z) 99.05 Cancel Ok

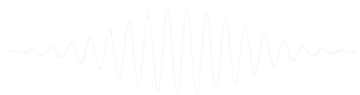
Check to see that electrodes are correctly matched

Select corresponding channels to pair

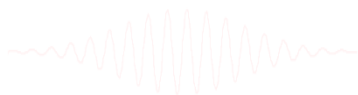
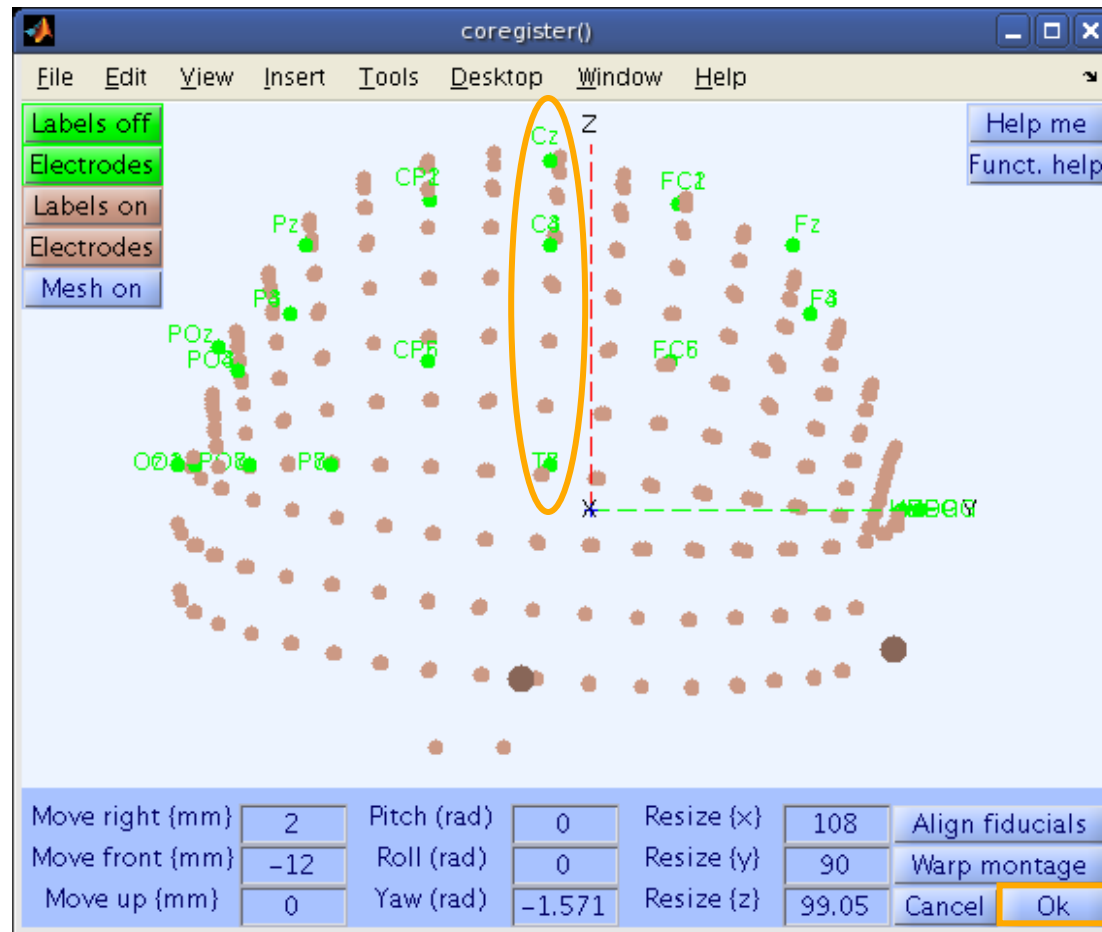
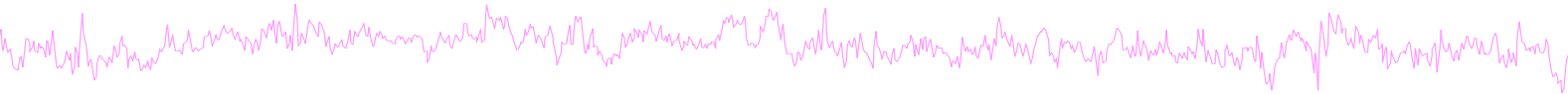
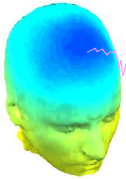
Plot new montage	Plot ref montage
1 - VEOG	1 - LPA
2 - F3 -> 21 - F3	2 - RPA
3 - Fz -> 23 - Fz	3 - Nz
4 - F4 -> 25 - F4	4 - Fp1
5 - HEOG	5 - Fpz
6 - FC5 -> 31 - FC5	6 - Fp2
7 - FC1 -> 33 - FC1	7 - AF9
8 - FC2 -> 35 - FC2	8 - AF7
9 - FC6 -> 37 - FC6	9 - AF5
10 - T7 -> 41 - T7	10 - AF3
11 - C3 -> 43 - C3	11 - AF1
12 - C4 -> 47 - C4	12 - AFz
13 - Cz -> 45 - Cz	13 - AF2
14 - T8 -> 49 - T8	14 - AF4
15 - CP5 -> 53 - CP5	15 - AF6
16 - CP1 -> 55 - CP1	16 - AF8
17 - CP2 -> 57 - CP2	17 - AF10
18 - CP6 -> 59 - CP6	18 - F9
19 - P7 -> 63 - P7	19 - F7
20 - P3 -> 65 - P3	20 - F5
21 - Pz -> 67 - Pz	21 - F3 -> 2 - F3
22 - P4 -> 69 - P4	22 - F1
23 - P8 -> 71 - P8	23 - Fz -> 3 - Fz
24 - PO7 -> 74 - PO7	24 - F2
25 - PO3 -> 76 - PO3	25 - F4 -> 4 - F4
26 - POz -> 78 - POz	26 - F6
27 - PO4 -> 80 - PO4	27 - F8
28 - PO8 -> 82 - PO8	28 - F10
29 - O1 -> 84 - O1	29 - FT9
30 - O2 -> 85 - O2	30 - FT7
31 - O2 -> 85 - O2	31 - FC5 -> 6 - FC5
31 - O2 -> 86 - O2	32 - FC3

Pair channels
Clear all pairs
Cancel
Clear this pair
Auto select
Ok

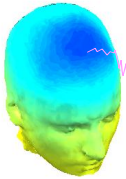
stats toolbox required for warping



Check coregistration with model



Confirm electrode transformation



Dipole fit settings - pop_dipfit_settings()

Head model (click to select): Spherical Four-Shell (BESA)
Boundary Element Model (MNI)
CTF MEG
Custom model files

Head model file: g:\lab\plugins\dipfit2.2\standard_BEM\standard_vol.mat [Browse] [Help]

Output coordinates: MNI [Click to select]

MRI file: g:\lab\plugins\dipfit2.2\standard_BEM\standard_mri.mat [Browse] [Help]

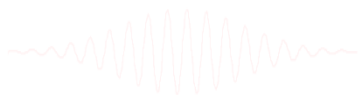
Model template channel locations file: g:\lab\plugins\dipfit2.2\standard_BEM\elec\standard_1005.elc [Browse] [Help]

Co-register chan. locs. with head model: **0 -1.570796 108 90 99.05485** [Manual Co-Reg.] [No Co-Reg.]

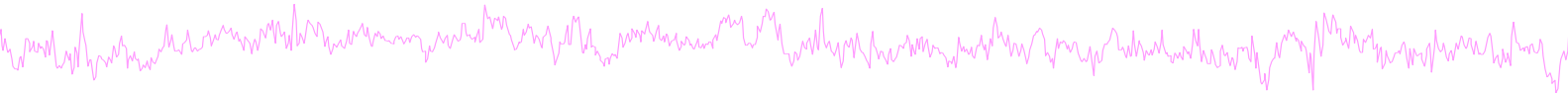
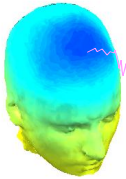
Channels to omit from dipole fitting: [List]

Note: For EEG, check that the channel locations are on the surface of the head model (To do this: 'Set head radius' to about 85 in the channel editor).

[Cancel] [Help] [Ok]



Co-register to model, cont'd



coregister() File Edit View Insert Tools Desktop Window Help

Labels on
Electrodes
Labels on
Electrodes
Mesh off

Help me
Funct. help

coregister() File Edit View Insert Tools Desktop Window Help

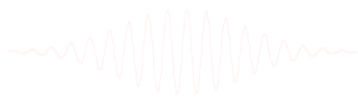
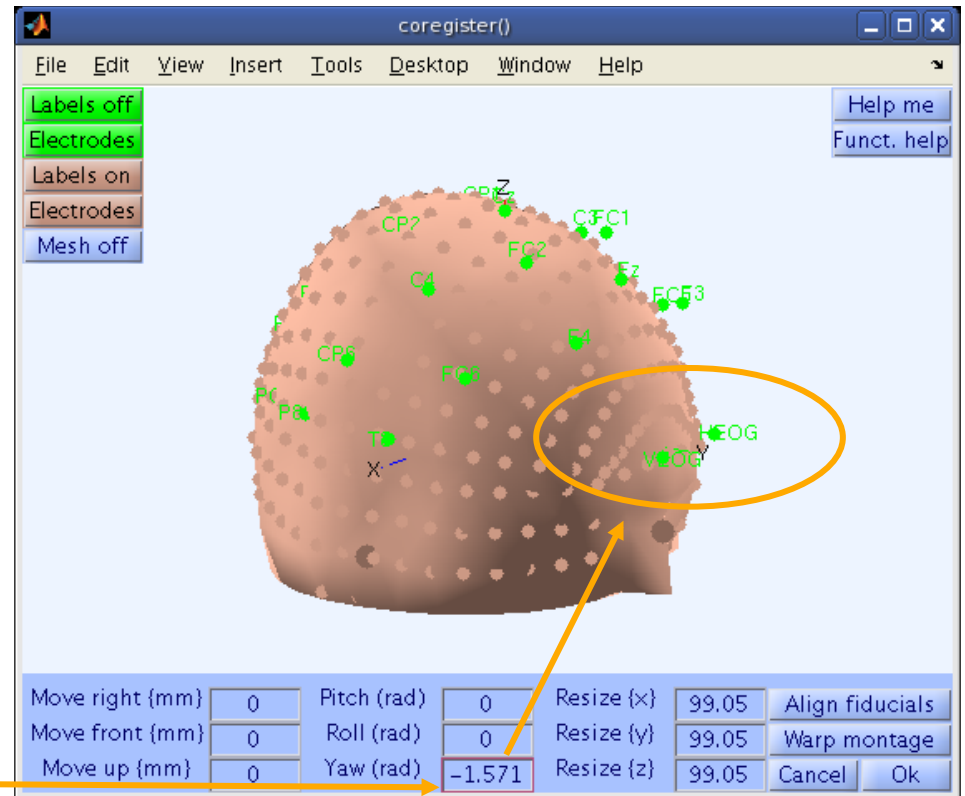
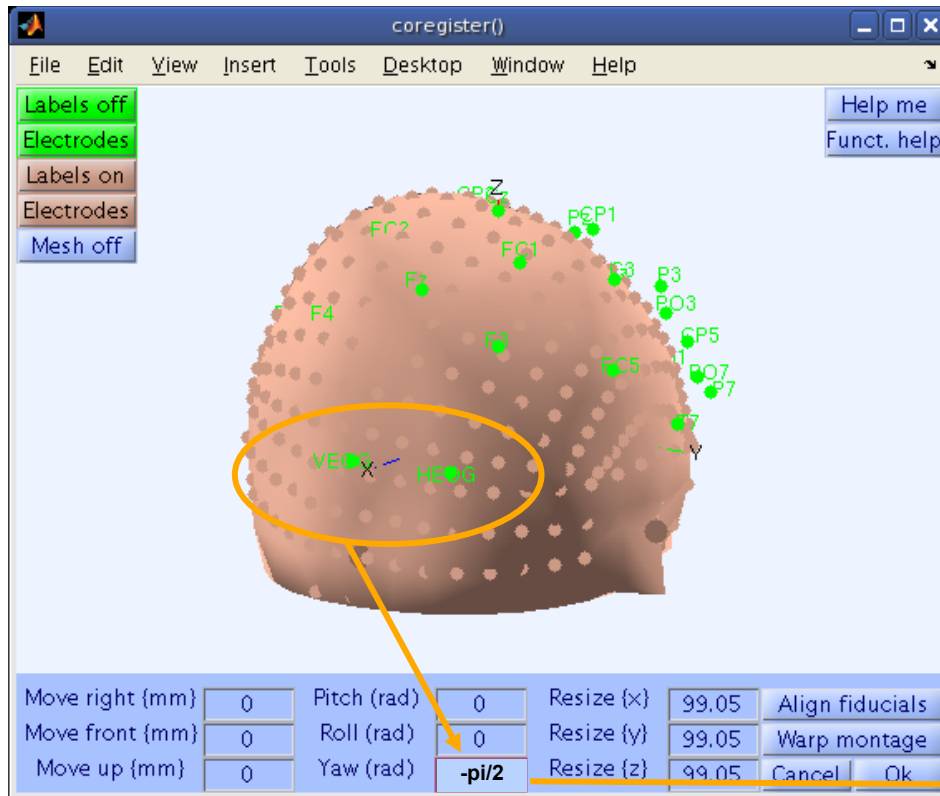
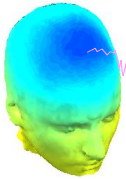
Labels off
Electrodes
Labels on
Electrodes
Mesh off

Help me
Funct. help

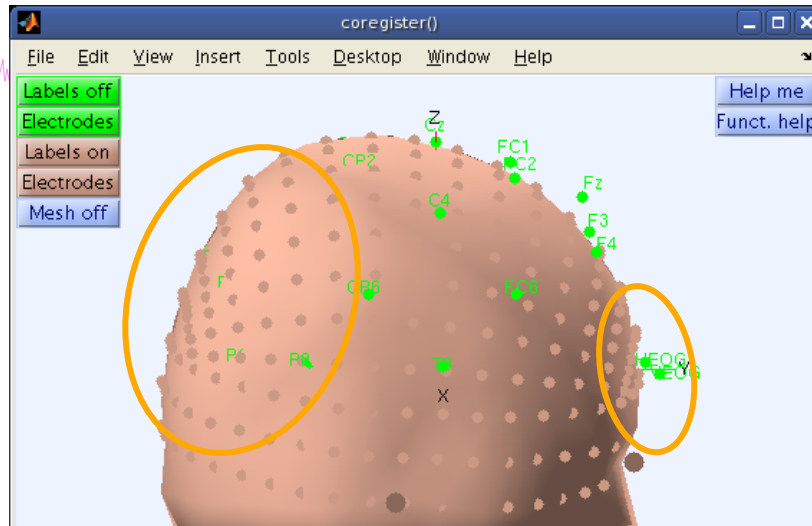
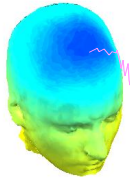
Move right (mm)	0	Pitch (rad)	0	Resize (x)	99.05	Align fiducials
Move front (mm)	0	Roll (rad)	0	Resize (y)	99.05	Warp montage
Move up (mm)	0	Yaw (rad)	0	Resize (z)	99.05	Cancel Ok

Move right (mm)	0	Pitch (rad)	0	Resize (x)	99.05	Align fiducials
Move front (mm)	0	Roll (rad)	0	Resize (y)	99.05	Warp montage
Move up (mm)	0	Yaw (rad)	0	Resize (z)	99.05	Cancel Ok

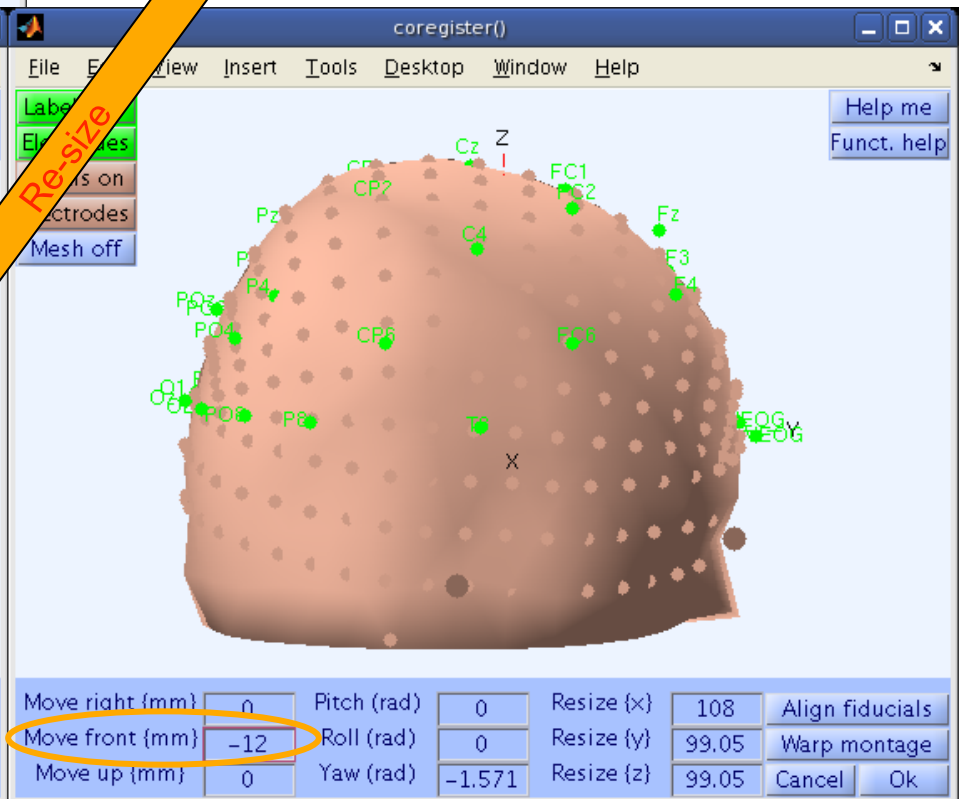
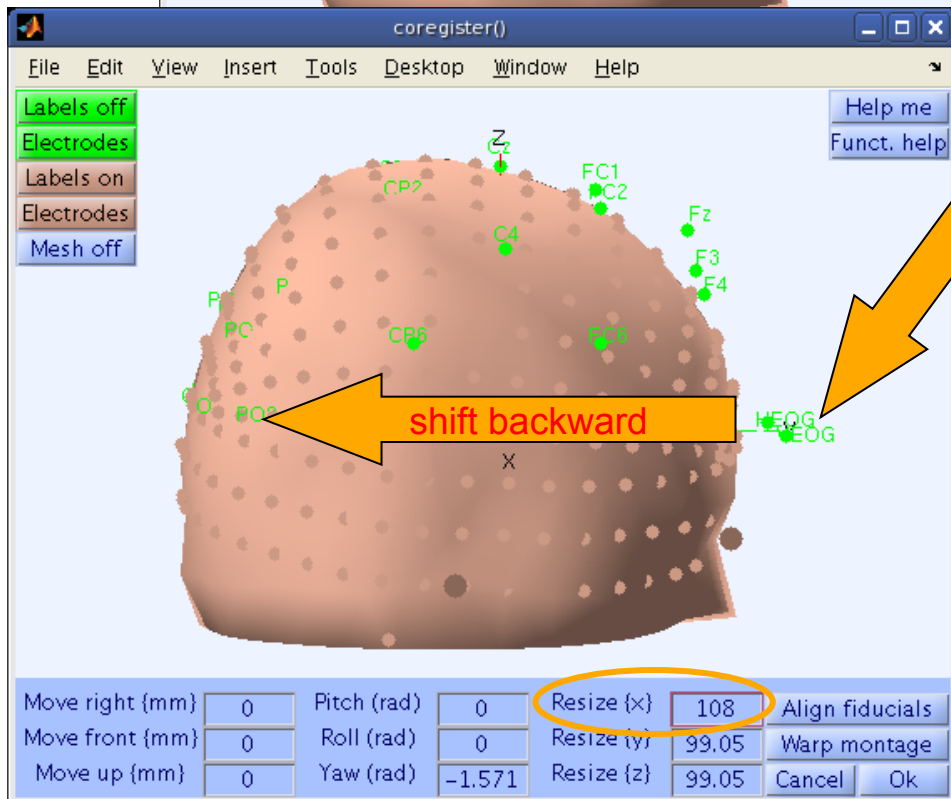
Perform translation of electrode positions



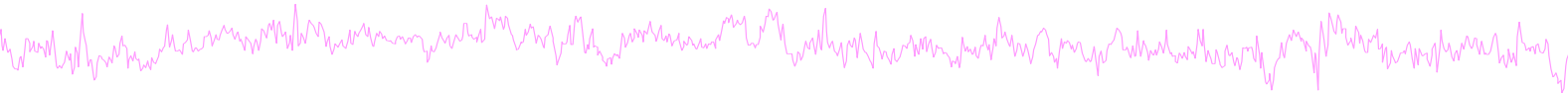
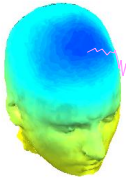
Perform translation of electrode positions



Requires a shift toward back of the head
AND
an expansion along the X-axis



Perform translation of electrode positions



coregister()

File Edit View Insert Tools Desktop Window Help

Labels off
Electrodes
Labels on
Electrodes
Mesh off

Help me
Funct. help

VEOG Y HOOG

Move right (mm)	0	Pitch (rad)	0	Resize (x)	108	Align fiducials
Move front (mm)	-12	Roll (rad)	0	Resize (y)	99.05	Warp montage
Move up (mm)	0	Yaw (rad)	-1.571	Resize (z)	99.05	Cancel Ok

coregister()

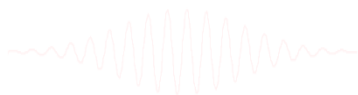
File Edit View Insert Tools Desktop Window Help

Labels off
Electrodes
Labels on
Electrodes
Mesh off

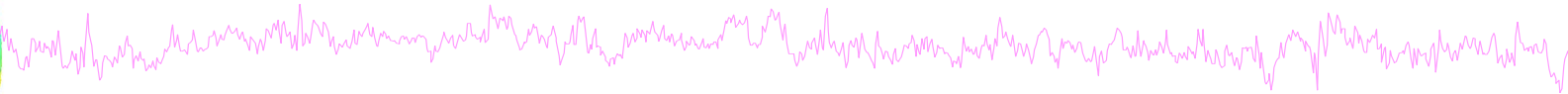
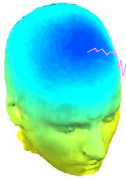
Help me
Funct. help

VEOG Y HOOG

Move right (mm)	2	Pitch (rad)	0	Resize (x)	108	Align fiducials
Move front (mm)	-12	Roll (rad)	0	Resize (y)	90	Warp montage
Move up (mm)	0	Yaw (rad)	-1.571	Resize (z)	99.05	Cancel Ok



EEG.dipfit structure



```
>> EEG.dipfit
```

```
ans =
```

```
    hdmfile: [1x76 char]
```

```
    mrifile: [1x71 char]
```

```
    chanfile: [1x83 char]
```

```
    chansel: [1x33 double]
```

```
    coordformat: 'spherical'
```

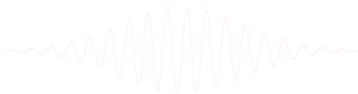
```
    model: [1x33 struct]
```

```
    current: 32
```

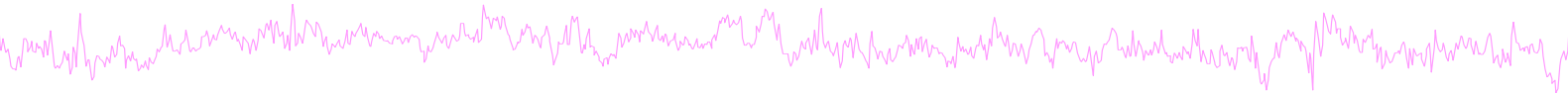
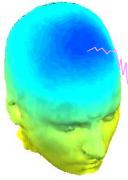
```
    vol: [1x1 struct]
```

```
    coord_transform: [0 0 -1.570796 100 76 90.87264 1 1 1]
```

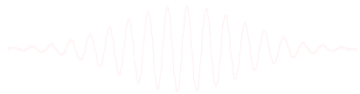
From head model transformations



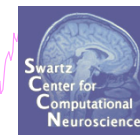
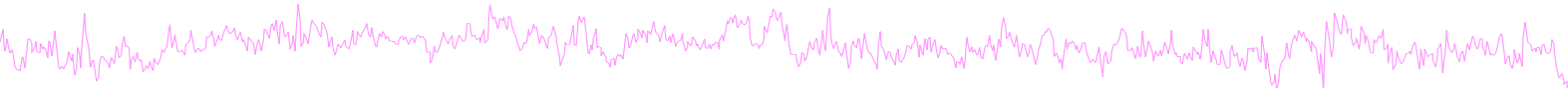
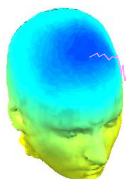
DIPFIT and model co-registration



1. Co-register electrodes with model
2. Autofit, plot dipoles, fine fit
3. 3D headplot co-registration



Autofit equivalent dipoles



EEGLAB v6.0b

File Edit **Tools** Plot Study Datasets Help

- Change sampling rate
- Filter the data
- Re-reference
- Reject continuous data by eye
- Extract epochs
- Remove baseline
- Run ICA**
- Remove components
- Automatic epoch rejection
- Reject data epochs
- Reject data using ICA
- Locate dipoles using BESA
- Locate dipoles using DIPFIT 2.x**
- Laplacian
- FMRIB Tools
- Grand average datasets
- Locate dipoles using LORETA
- PCA plugin

Fit multiple ICA components -- pop_multifit()

Component indices: 1:71

Rejection threshold RV (%): 100

Remove dipoles outside the head:

Fit bilateral dipoles (check):

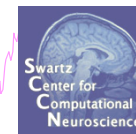
Plot resulting dipoles (check):

dipplot() plotting options: 'normlen' 'on' Help

Cancel Help Ok

- Head model and settings
- Coarse fit (grid scan)
- Fine fit (iterative)
- Autofit (coarse fit, fine fit & plot)**
- Plot component dipoles

Plot dipoles



Plot dipoles - pop_dipplot

Components indices ([]=all available)

Plot dipoles within RV (%) range ([min max])

Background image ... /data/common/matlab/eeglab/plugins/c

Plot summary mode

Plot edges

Plot closest MRI slide

Plot dipole's 2-D projections

Plot projection lines

Make all dipoles point out

Normalized dipole length

Additional dipplot() options

Cancel Help



Figure 2

File Edit View Insert Tools Desktop Window Help

71 dipoles:

Plot one

Keep|Next

Next

Prev

Keep|Prev

1

Comp: 1

RV: 9.92%

X tal: 4

Y tal: 67

Z tal: -37

Display:

Mesh on

Tight view

Sagittal view

Coronal view

Top view

No controls

EEGLAB v6.0b

File Edit Tools Plot Study Datasets Help

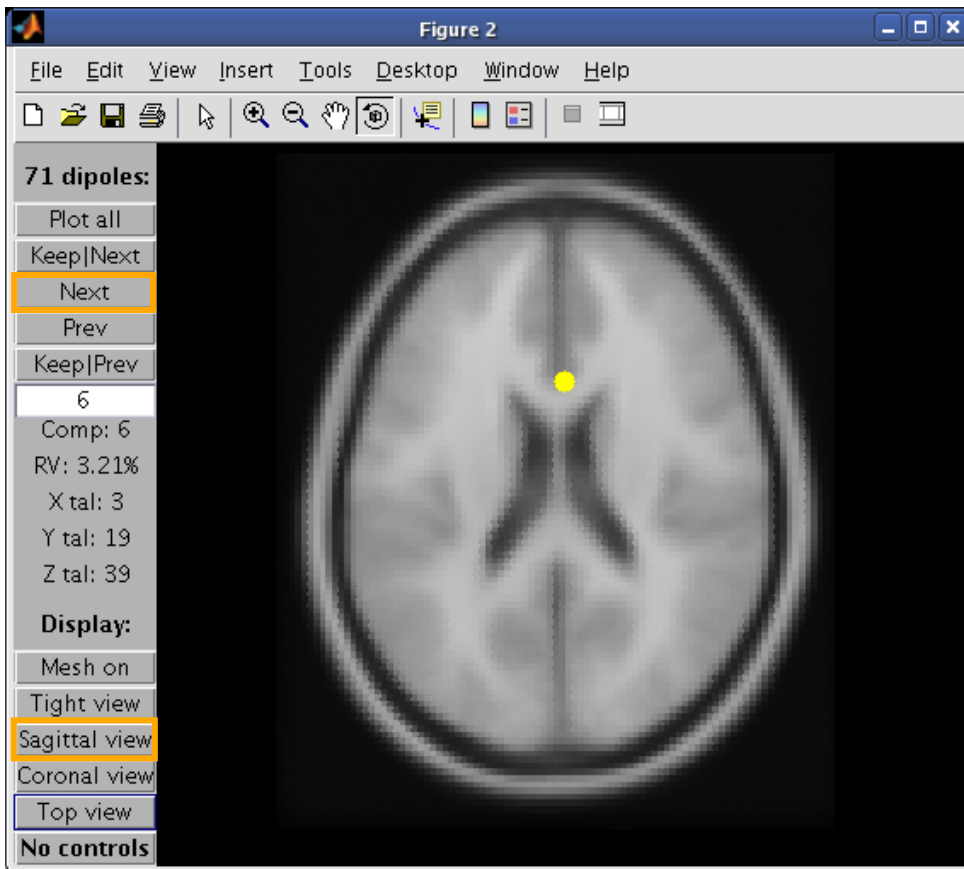
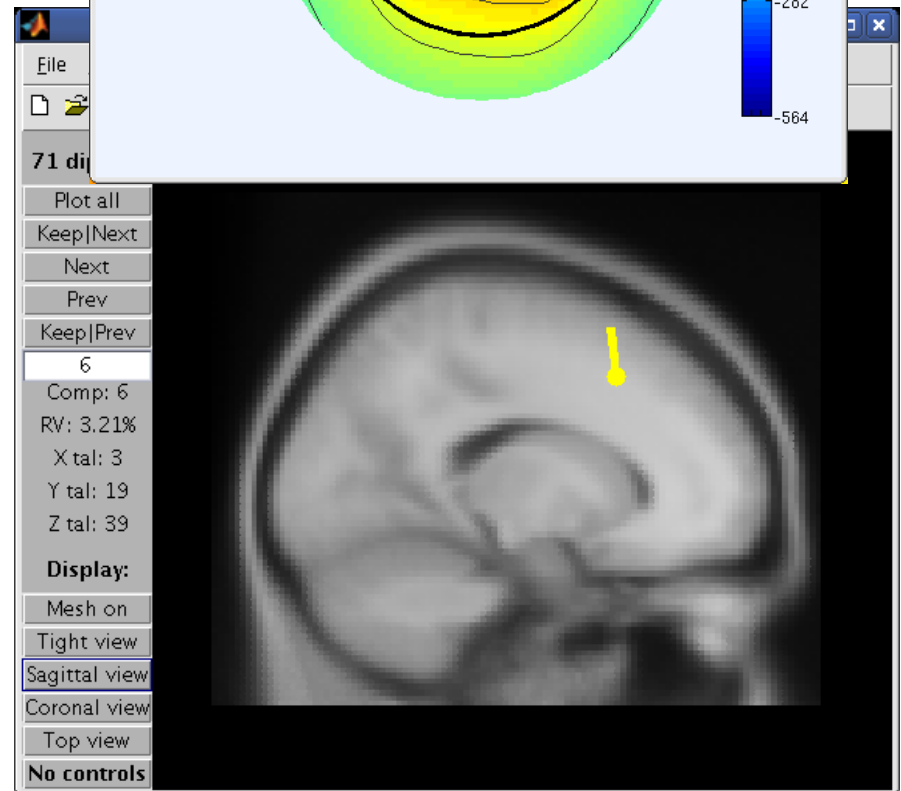
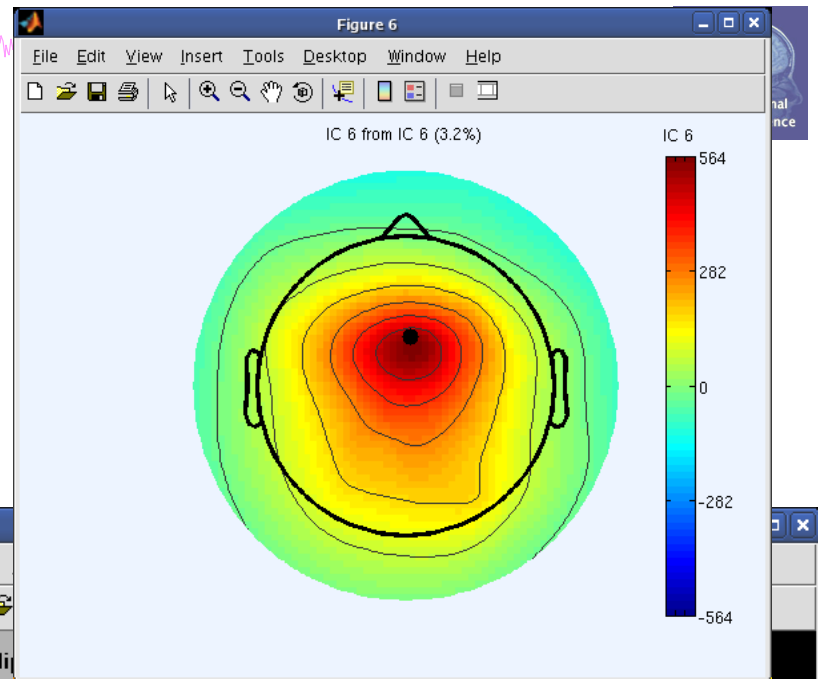
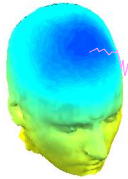
#1: (

File Edit Tools Plot Study Datasets Help

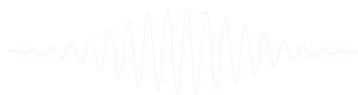
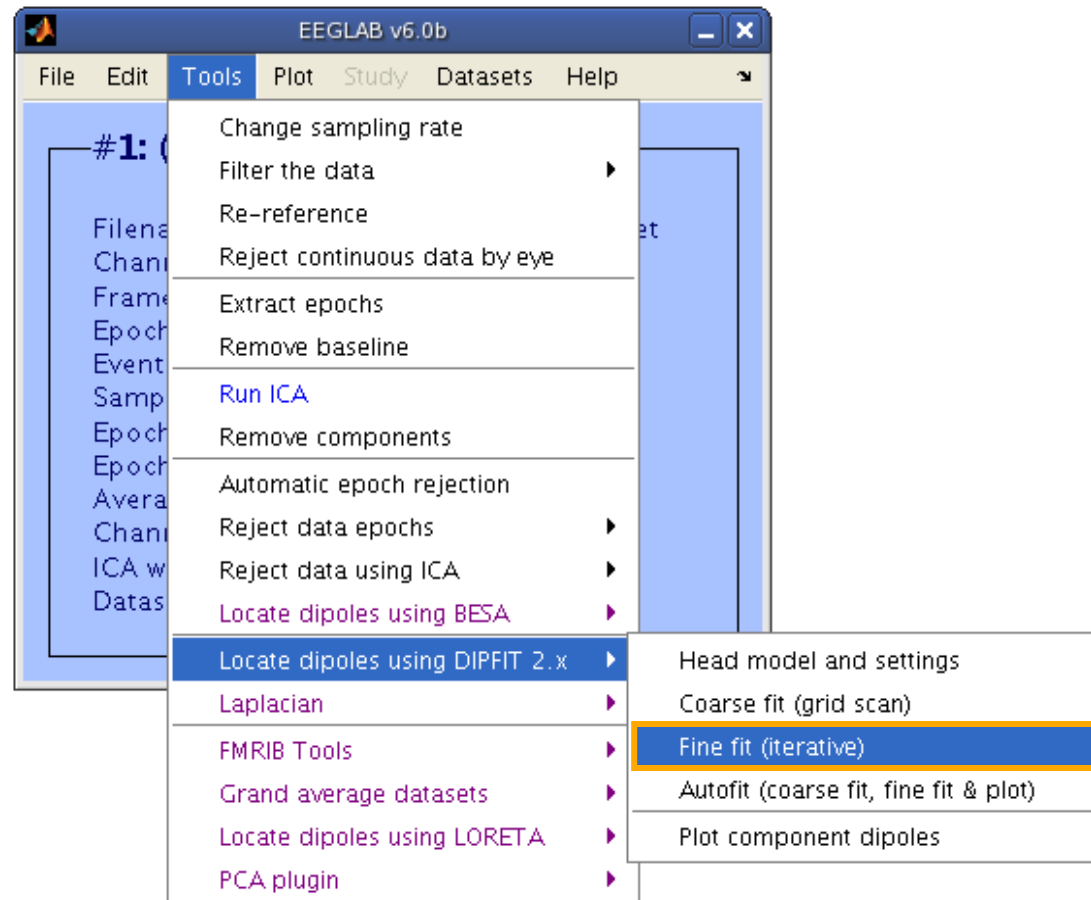
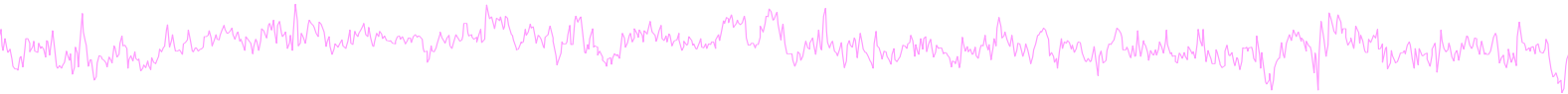
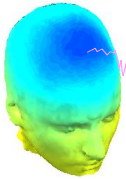
- Change sampling rate
- Filter the data
- Re-reference
- Reject continuous data by eye
- Extract epochs
- Remove baseline
- Run ICA
- Remove components
- Automatic epoch rejection
- Reject data epochs
- Reject data using ICA
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 - Laplacian
 - FMRIB Tools
 - Grand average datasets
 - Locate dipoles using LORETA
 - PCA plugin

- Coarse fit (grid scan)
- Fine fit (iterative)
- Autofit (coarse fit, fine fit & plot)
- Plot component dipoles

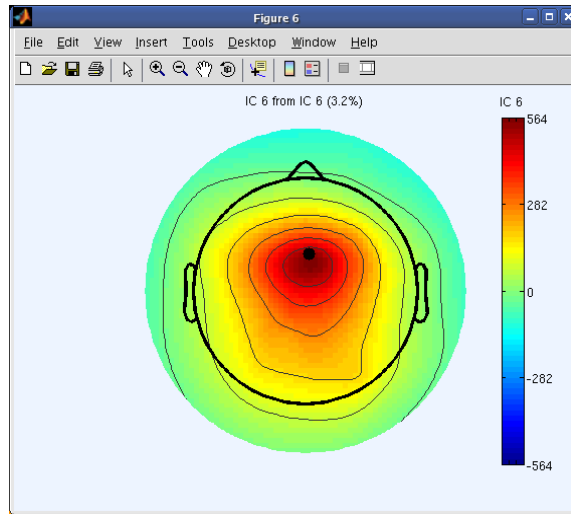
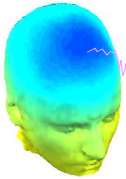
Scroll through dipoles



Fine fit options in DIPFIT



Fine fit menu



Manual dipole fit -- pop_dipfit_nonlinear()

Component to fit: 6 Plot map Residual variance = 3.21%

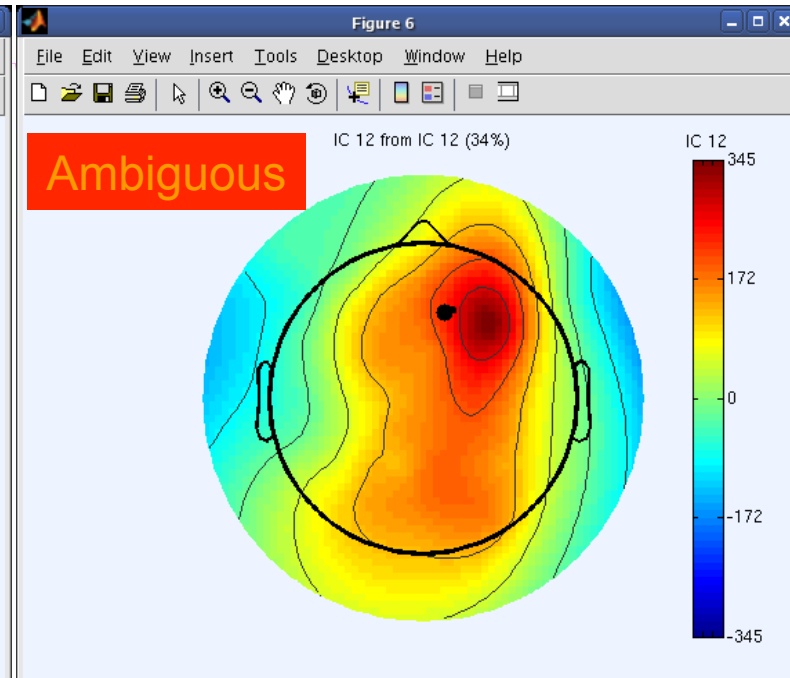
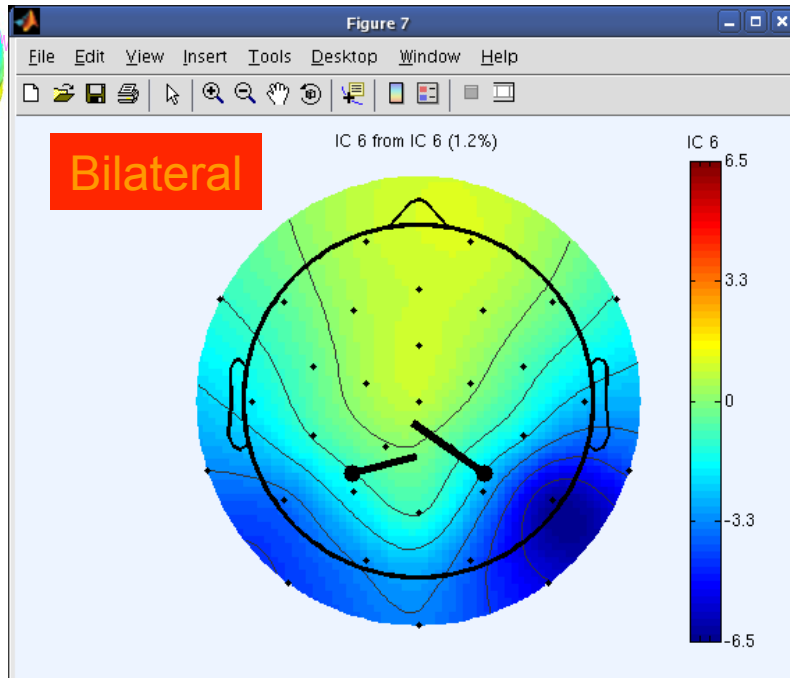
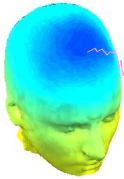
dipole	fit	position	moment	
#1	<input checked="" type="checkbox"/>	28.222 -2.401 37.331	2.380 475942.653 3819304.288	Flip (in/out)
#2	<input type="checkbox"/>	0.000 0.000 0.000	0.000 0.000 0.000	Flip (in/out)

Symmetry constrain for dipole ...

Fit dipole(s)' position & moment Or fit only dipole(s)' moment Plot dipole(s)

Cancel Help Ok

Bilateral dipoles



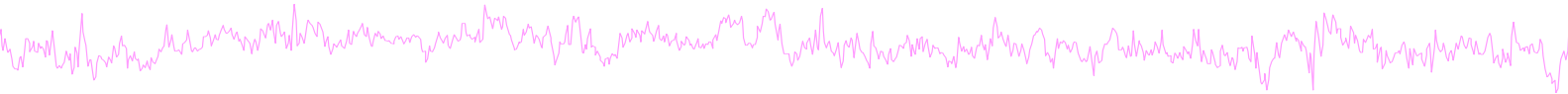
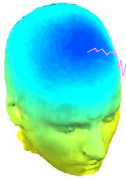
Manual dipole fit -- pop_dipfit_nonlinear()

Component to fit: Residual variance = 1.23%

dipole	fit	position	moment	
#1	<input checked="" type="checkbox"/>	-35.066 -32.492 -4.684	32271.382 46141.284 5880.224	<input type="button" value="Flip (in out)"/>
#2	<input checked="" type="checkbox"/>	-35.066 32.492 -4.684	1005.419 -38050.427 14094.824	<input type="button" value="Flip (in out)"/>

Symmetry constrain for dipole ...

EEG.dipfit structure



```
>> EEG.dipfit.model
```

```
ans =
```

```
1x33 struct array with fields:
```

```
posxyz
```

```
momxyz
```

```
rv
```

```
active
```

```
select
```

```
>> EEG.dipfit.model(1)
```

```
ans =
```

```
           X           Y           Z  
[14.9791  -86.0094  47.9448]
```

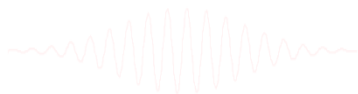
```
posxyz: [1x3 double]
```

```
momxyz: [1x3 double]
```

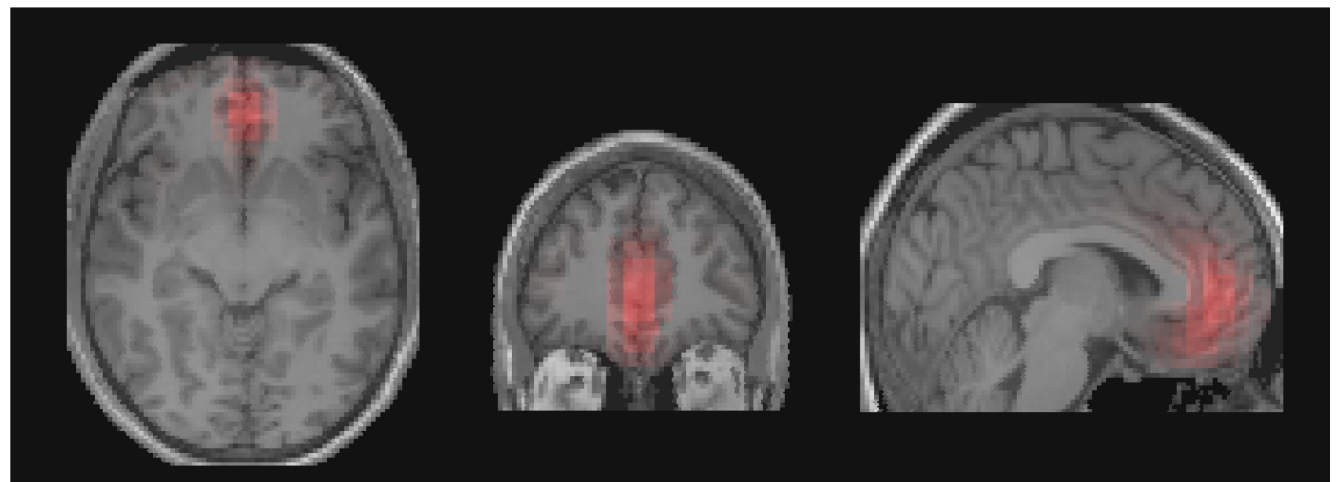
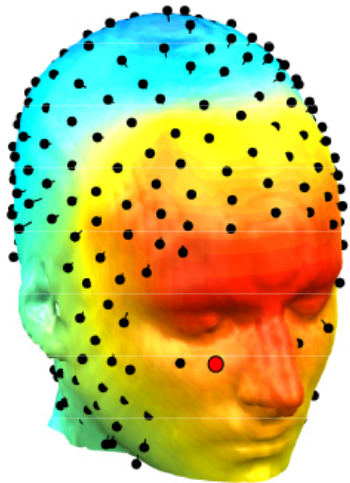
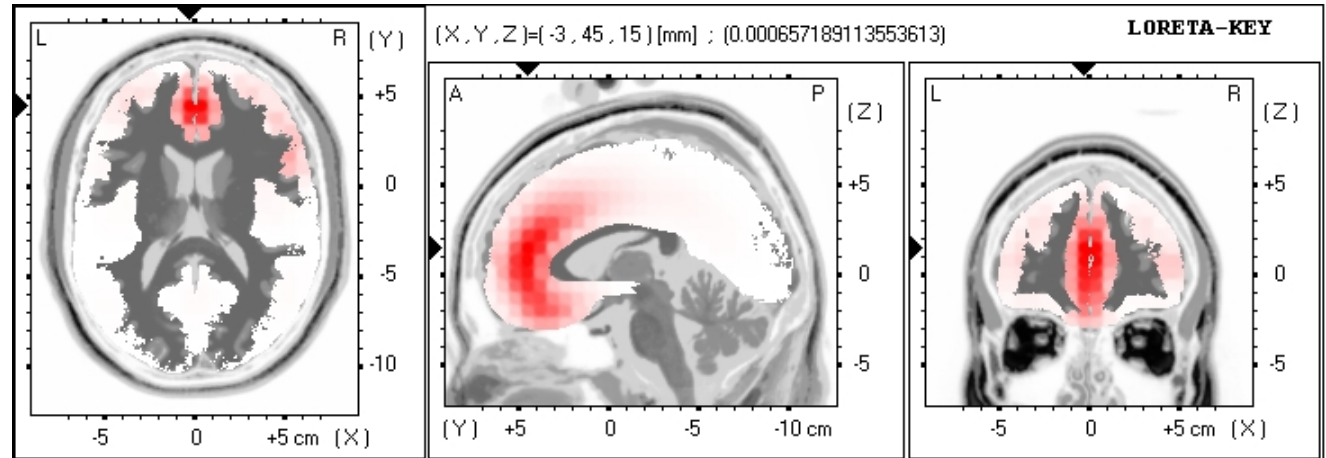
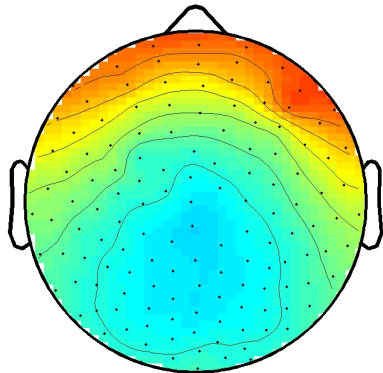
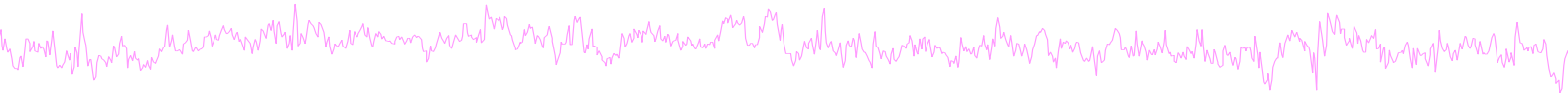
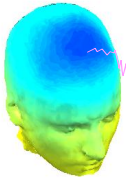
```
rv: 0.0288
```

```
active: 1
```

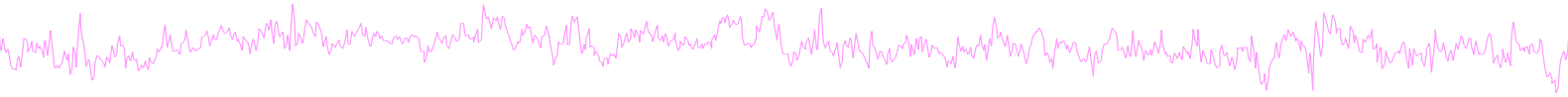
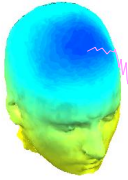
```
select: 1
```



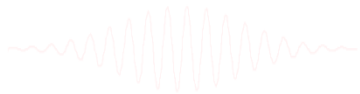
Localization of activity using Loreta



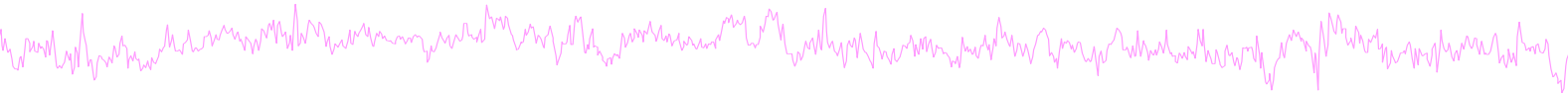
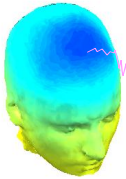
DIPFIT and model co-registration



1. Co-register electrodes with model
2. Autofit, plot dipoles, fine fit
3. 3D headplot co-registration



Plot scalp maps in 3D



The screenshot shows the EEGLAB v6.0b software interface. The 'Plot' menu is open, and 'Component maps' is selected. A sub-menu is visible with 'In 3-D' highlighted. A warning dialog box is also present, stating: 'headplot() must generate a spline file the first time it is called or after changes in the channel location file. You must also co-register your channel locations with the head template. Ok'.

EEGLAB v6.0b

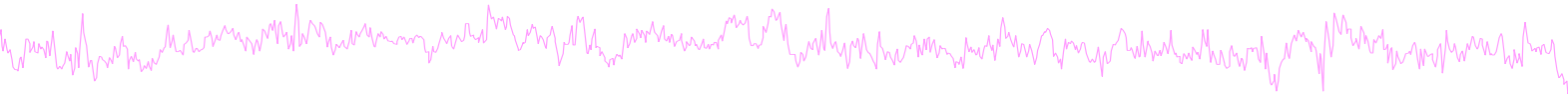
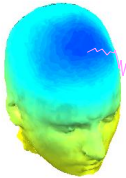
File Edit Tools **Plot** Study Datasets Help

#1: (no d...
Filename: ...
Channels pe...
Frames per e...
Epochs
Events
Sampling rat...
Epoch start (...
Epoch end (s...
Average refe...
Channel loca...
ICA weights
Dataset size

- Channel locations
- Channel data (scroll)
- Channel spectra and maps
- Channel properties
- Channel ERP image
- Channel ERPs
- ERP map series
- Sum/Compare ERPs
- Component activations (scroll)
- Component spectra and maps
- Component maps**
 - In 2-D
 - In 3-D**
- Component properties
- Component ERP image
- Component ERPs
- Sum/Compare comp. ERPs
- Data statistics
- Time-frequency transforms
- Average time-frequency
- Cluster dataset ICs



Headplot co-registration



Component head plot(s) -- pop_headplot()

Co-register channel locations with head mesh and compute a mesh spline file (done only once)

Use the following spline file or structure

Or (re)compute a new spline file named:

3-D head mesh file

Mesh associated channel file

Talairach-model transformation matrix

/home/julie/S01_attend1_pos1.spl

mheadnew.mat

mheadnew.xyz

Browse

Help

Browse

Help

Browse

Browse

Manual coreg.

1:31

Components of dataset:

Ok

coregister()

File Edit View Insert Tools Desktop Window Help

Labels off

Electrodes

Labels on

Electrodes

Mesh off

Help me

Funct. help

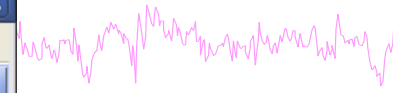
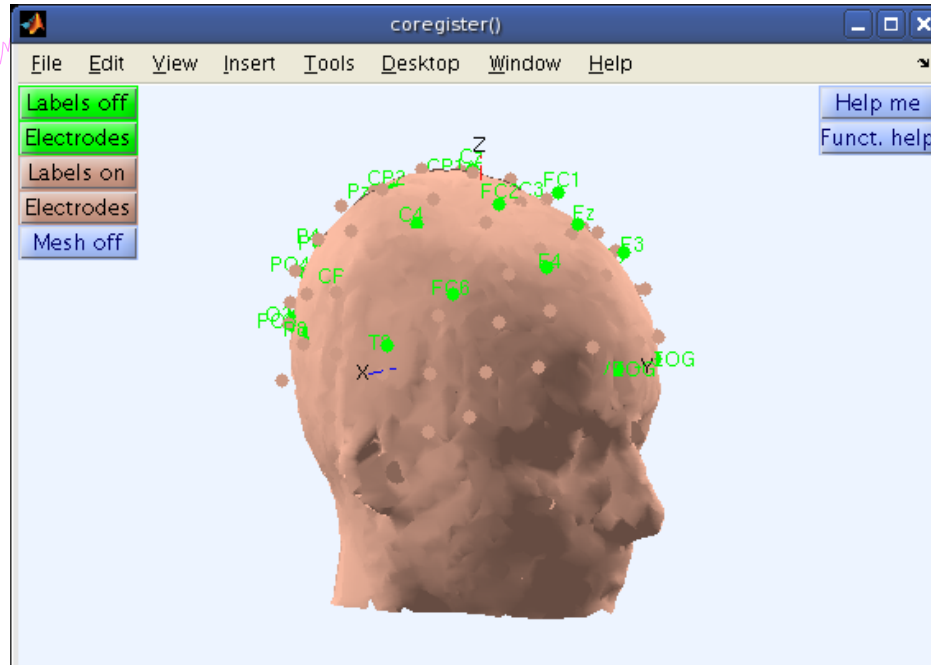
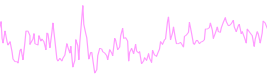
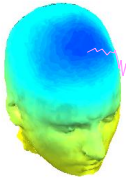
Move right {mm} 0 Pitch (rad) 0 Resize {x} 90.87 Align fiducials

Move front {mm} 0 Roll (rad) 0 Resize {y} 90.87 Warp montage

Move up {mm} 0 Yaw (rad) 0 Resize {z} 90.87 Cancel Ok

Go through co-registration in the same way as with dipfit co-registration

Confirm headplot co-registration



Component head plot(s) -- pop_headplot()

Co-register channel locations with head mesh and compute a mesh spline file (done only once)

Use the following spline file or structure

Or (re)compute a new spline file named:

3-D head mesh file	/home/julie/S01_attend1_pos1.spl	Browse	Help
Mesh associated channel file	mheadnew.mat	Browse	Help
Talairach-model transformation matrix	mheadnew.xyz	Browse	Help
	0 0 -1.570796 100 76 90.87264	Manual coreg.	

Plot interpolated activity onto 3-D head

Component numbers to plot (negative numbers invert comp. polarities):

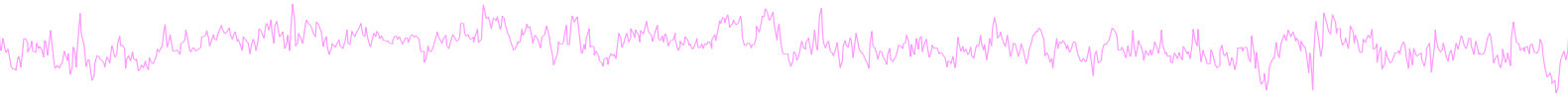
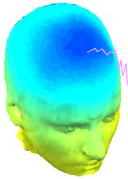
Plot title:

Plot geometry (rows,columns): (Default [] = near square)

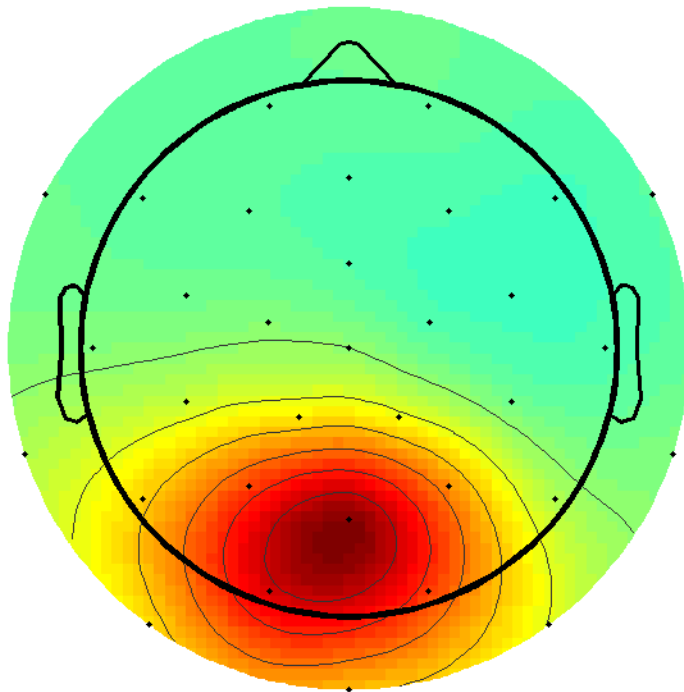
-> headplot() options (See >> help headplot):

Cancel Ok

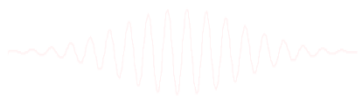
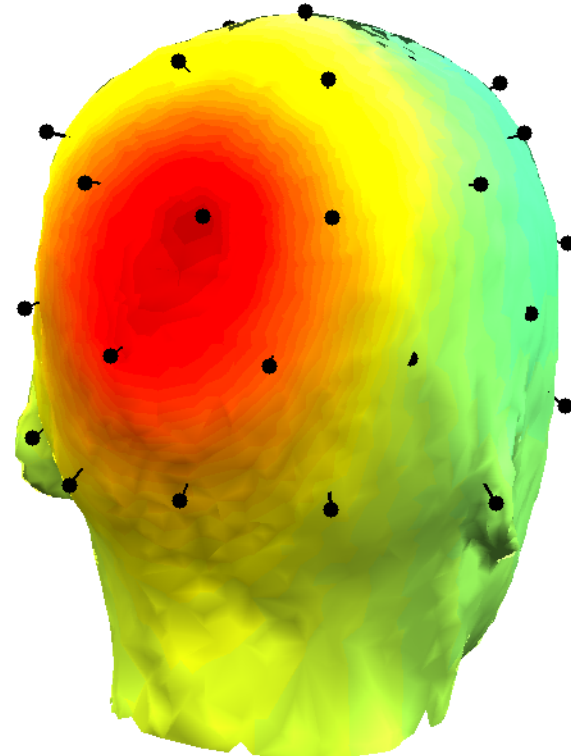
Spline file in EEG structure



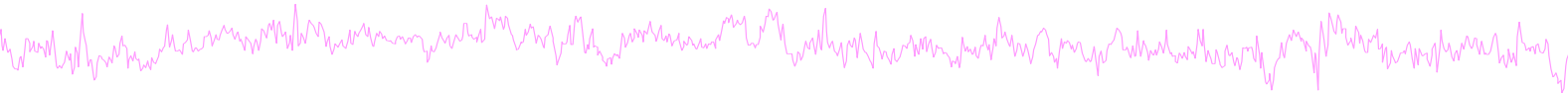
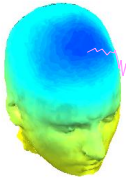
2D scalp map for IC 12



3D scalp map for IC 12



Exercise



- **Novice / Intermediate**

- Load 'stern_125.set'
- Practice co-registering electrodes with **BEM** model (choose 'Erase' because this dataset has co-registration done already)
- Autofit IC dipoles
- Fine fit dipoles
- Plot dipoles from the GUI; scroll through components individually
- Co-register the head model for 3D scalp map plotting. Then plot some ICs in 3D

- **Advanced**

- In the Finefit menu, try fitting a bilateral dipole, what happens to the residual variance?
- Try plotting a subset of dipoles in 'summary mode'
- Try purposely misaligning electrodes with model, how far off are the resulting dipoles from the original locations?

