COMBINED MEG/EEG-SOURCE ANALYSIS



- Start Curry: *double-click* the **Curry 7** icon.
- Open the following database:
 C:\Curry 7 Course\Source Analysis\MEG EEG Somatosensory\MEG EEG.mdb
- Expand Subject SEP & SEF.
- Open study MEG EGG MRI. (the data import wizard does not appear as data have already been parameterized)
- Select **Butterfly Plot** \bigotimes (*Alt+B*).

- In Noise Estimation, use Pretrigger Interval.
- Use **14...26ms** as the analysis timerange (*Ctrl/Alt+left/right cursor keys*).



For combined EEG and MEG analysis, data from both modalities must be stored in the same data file or in separate matching (sampling rate, number of samples) files with MEG first.

PCA ANALYSIS

Use PCA for MEG and EEG alone and combined to learn about data complexity:

- *Ctrl-click* to change the display but not the parameters.
- From the toolbar, activate a PCA 🗱.
- In the EFunctional Data parameters, expand Channel Groups / Rereferencing
- Take a look at the PCA components and their SNRs for MEG&EEG combined, MEG alone, and EEG alone:
- Uncheck EEG.
- Check EEG, uncheck MEG.
- Check **EEG** and **MEG**.

Char	nel Gro	ups / Rerefere	ncing
Data Paran	neters		
Channels:	62	Samples:	256
Epochs:	1	Rate[Hz]:	1000
Active Cha	nnel Gr	oups / Referen	ice
MEG		<off></off>	
EEG		<car></car>	Þ



MEG data shows higher SNR and less complexity.

DIPOLE ANALYSIS

Perform dipole fits for the different modalities and observe the achieved goodness-of-fit:

- Switch to the Maps, 3D View display.
- In **Dipole Fit**, change the **Dipole Type** to **Moving**.
- From the toolbar, activate MGFP, Dipole Strengths, and Goodness-Of-Fit the achieved goodness-of-fit is well below the expected goodness-of-fit (dotted line).
- In Channel Groups / Rereferencing (*click* EFunctional Data parameters), uncheck EEG. For most samples, achieved and expected goodness-of-fit match.
- Check EEG and uncheck MEG. Achieved and expected goodness-of-fit match.
- Check both **EEG** and **MEG**.
- In Head Model (*click* Source Reconstruction parameters), press Conductivity Factor: Fit. The conductivity factor (2.22) is fitted. Achieved and expected goodness-of-fit match.
- Change dipole type **Fixed MUSIC**, set **Number of Dipoles** to **3**.



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The MEG-EEG **head model conductivity factor** is a calibration factor for the conductivities which are used for an EEG analysis. (MEG signal strengths only depend on relative conductivities, while EEG signal strengths depend on absolute conductivities.)

M Fuchs, *M* Wagner et al., 1998. Improving source reconstructions by combining bioelectric and biomagnetic data. Electroenceph clin Neurophysiol 107:93-111

IMAGE ANALYSIS

Load image data and view the dipole results in their anatomical context:

- Switch to the III Image Data display.
- Make sure Time Range mode is activated (press 📽 toolbar button).
- Step through the dipole results using the **Previous/Next Dipole** toolbar buttons 💰 💰.
- Zoom in and out using the + and keys.
- Press the **Setup BEM Geometry** toolbar button 🙋.
- Change **Create** to **Cortex** and press **Start**.



The **Previous/Next Dipole** toolbar buttons iterate through the active dipole results.

CUTPLANE OVERLAY

View the dipole results in their anatomical context:

- Switch the display to **O**^{3D} View and switch to **Right View**, slightly rotate the cortex surface and zoom in using the mouse wheel.
- Switch off 🗆 😥 Functional Landmarks , 🗆 🐼 Anatomical Landmarks , 🗆 🕢 Electrodes , and 🗆 🧖 Coils .
- In the Cortex (129) 2.5mm properties set Cutplane Mode Triple and
 Through 3D Cursor
- Make sure **Time Range mode** is activated (press ***** toolbar button).
- Step through the dipole results using the **Previous/Next Dipole** toolbar buttons 💰 💰.

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• Switch on 🗹 🐼 Functional Landmarks , 🗹 🐼 Anatomical Landmarks , 🗹 🐼 Electrodes , and 🗹 🗱 Coils .

Off

• In the Cortex (129) 2.5mm properties set Cutplane Mode

The **Image Data** display can also be used to set the 3D Cursor position for the cutplanes.

CURRENT DENSITY ANALYSIS

Perform a cortical current density analysis:

- Switch to the Maps, 3D View display, Top View
- Perform an **sLORETA** analysis using the cortical mesh (**Cortex (129) 2.5mm**) as the source space.
- Activate ICA and perform a Component-Based sLORETA CDR for the first three ICA components.

(*Ctrl-click* a component to deselect all others)



Component-Based CDR allows to compute the source image per ICA component.

DISPLAY CONTROL

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View results within Curry:

- In Output, in the upper right corner, press the Maximize button The output field fills the whole display area.
- Press the **Shrink** button

1

SNR: 9.2, residual deviation (normalized, original): 71.5%, 100%, variance: 48.94%, 0.00%
(max 2873): q=20.7, (-0.54, 0.44, -0.72), 5.1ml
SNR: 7.9, residual deviation (normalized, original): 49.2%, 36.3%, variance: 75.75%, 86.83%
 achieved miative deviation: 1.78e+003% (+36.5x49.2%), lambda (used, fitted): 11757, 1175
Beauts (1 moving) for 1 source, 14.0 26.0ms (13 samples):
(-11.7, -29.1, 11.4)mm, q=3.36µAmm, (0.09, -0.71, -0.70), 286.7ml
SNR: 3.0, residual deviation (normalized, original): 44.4%, 82.7%, variance: 80.26%, 31.67%
(-0.3, -29 1, 13.5)mm, g=4.37µAmm, (0.07, -0.81, -0.58), 68.4ml
SNR: 3.9, residual deviation (normalized, original): 31.1%, 92.9%, variance: 90.35%, 13.71%
(8.9, -25.5, 18.6)mm, q=4.40µAmm, (0.03, -0.80, -0.60), 42.4ml
SNR: 4.1. residual deviation (normalized, original); 31.4%, 70.9%, variance: 90.17%, 49.71%
(24.8, 8.1, 61.4)mm, q=1.41µAmm, (0.21, -0.91, -0.36), 44.0ml
SNR: 2.8, residual deviation (normalized, original): 43.9%, 36.7%, variance: 80.70%, 86.53%
(41.7, 15.5, 84.2)mm, q=1.30µAmm, (0.36, -0.93, 0.12), 1.9ml
SNH: 6.4, residual deviation (normalized, original), 16.9%, 10.0%, variance: 97, 15%, 98, 99%
(41.7, 15.4, 83.8mm, q=3.21µAmm, (0.30, -0.94, 0.18), 0.1ml
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(42.0, 15.8, 83.6 mm, q=5.91µ9mm, (0.20, -0.97, 0.14), 0.0ml
5101 25.5. resource deviation promatized, original/ 8.77%, 4.16%, variance: 33.23%, 33.83%
(42.6, 17.0, 65.5)mm, qv7.25(24mm, (0.06, -1.00, 0.07), 0.0mi
51(1) 30.1 redoual deviation (normalized, original), 7 404, 3.434, Vatiance, 33.454, 33.964 (13.9, 16.7, 93.0 mm, arXiv: 10.73, 0.96, 0.16, 0.04)
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/06.6. 20.3. 97.5mm, n=3.04u/am, (-0.65, -0.10, -0.83, 0.4m)
SNR-9.2 residual deviation inormalized opinion 10.4% 59.7% variance 90.75% 64.31%
(31.7, 16.7, 87.1)mm, q=2.72uAmm, (0.56, 0.30, -0.77), 1.0ml
SNR: 7.9 residual deviation increalized original: 24.2%, 21.2% variance: 94.13%, 95.52%

- Switch the display to Localize.
- *Right-click* and select **Import Dipoles**.
- In Localize, in the upper left of the location list, press the Maximize button 🔄. The Localize list is completely visible.
- Press the **Shrink** button **Shrink**.

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Maximize buttons make it possible to focus on a part of the display or the user interface.

REPORTS

Paste results and images to the Report:

• Switch to the Report.

- From the **Source Results** menu, select **Report** and **Append Dipole Description**. (or press the store to button). Dipole results are appended to the report.
- In the 3D View display, *right-click* and select **Hardcopy** and **Append Image to Report** (or *Ctrl+Shift+R*). The image is appended to the report.
- *Right-click* the **Report** and select **Open in Editor...**. Microsoft Word or another Rich Text Format (rtf) editor opens.
- From the **Edit** menu, select **Options...** and switch to the **Hardcopies** page. On this page, the resolution of hardcopies and movie files can be adjusted.



The **Report** module can be used to collect textual and pictorial results. It is a convenient alternative to saving multiple screenshots.

RESULTS EXPORT

Export results in Excel and MATLAB formats:

- From the Source Results menu, select Export Results and Export Dipoles to Excel...
- Enter a filename and check **Open in Excel**. Press **Save**. A .csv file is written, Excel opens, and dipoles are displayed as a spreadsheet.

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10	22	42,8	16,7	83	6,47	-0,22	-0,96	-0,16	0	1	1,9	2,4	10	4,39	98,99	99,81
11	23	43.8	17,3	83,6	4,68	-0,53	-0.71	-0,47	0,1	1.9	2,5	4.2	20,1	11,3	95,94	98,73
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13	25	36,6	20,3	97,5	3.04	-0,55	-0,1	-0.83	0.4	2,8	4,3	8,8	30,4	59,7	90,76	64,31
14	26	31.7	16,7	87.1	2,72	-0,56	0,3	-0,77	1	4,5	5,1	10,8	24,2	21,2	94,13	96,62
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- From the Source Results menu, select Export Results and Export Currents to MATLAB...
- Enter a filename and check **Open in MATLAB**. Press **Save**. MATLAB opens (better if already running) and currents are displayed.





• Exit Curry

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When exporting to **Excel**, a Comma Separated Values (csv) file is written (can be opened in all spreadsheet programs).

When exporting to **MATLAB**, a .mat file is written. If **Open in MATLAB** is checked, a sample .mfile is additionally written, showing how to access the exported data.