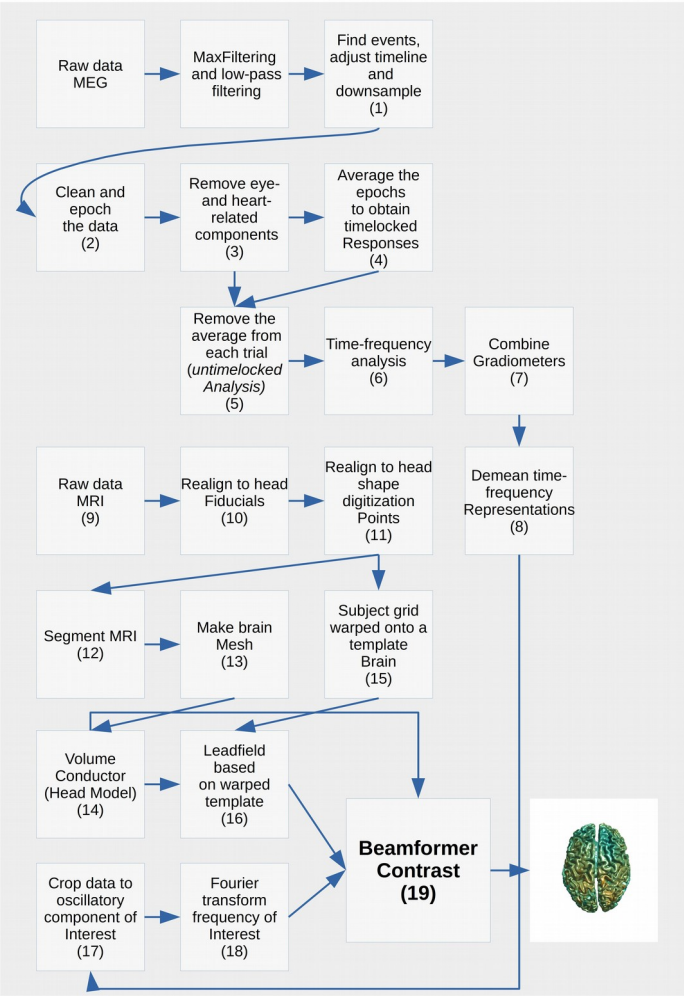
From raw data to single subject source analysis

by: Lau M. Andersen and Mikkel Vinding

Single Subject Pipeline



Andersen, L.M., 2018. Front. Neurosci. 12.

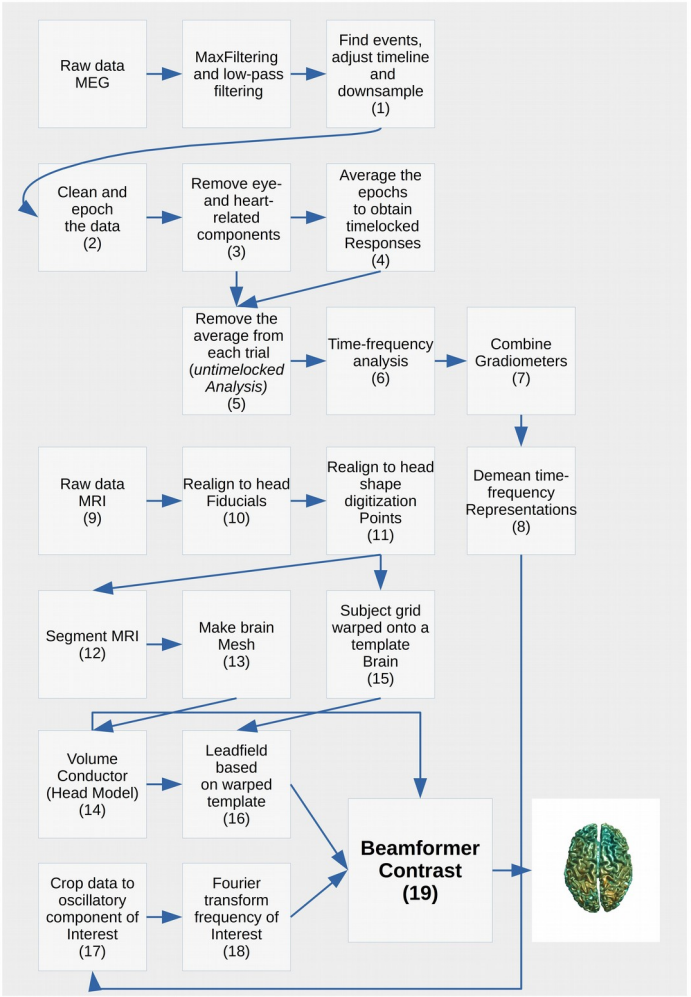
Single Subject Pipeline

Three sections

1) *Preprocess MEG data*

2) Preprocess MR data

3) Do source analysis (beamformer)



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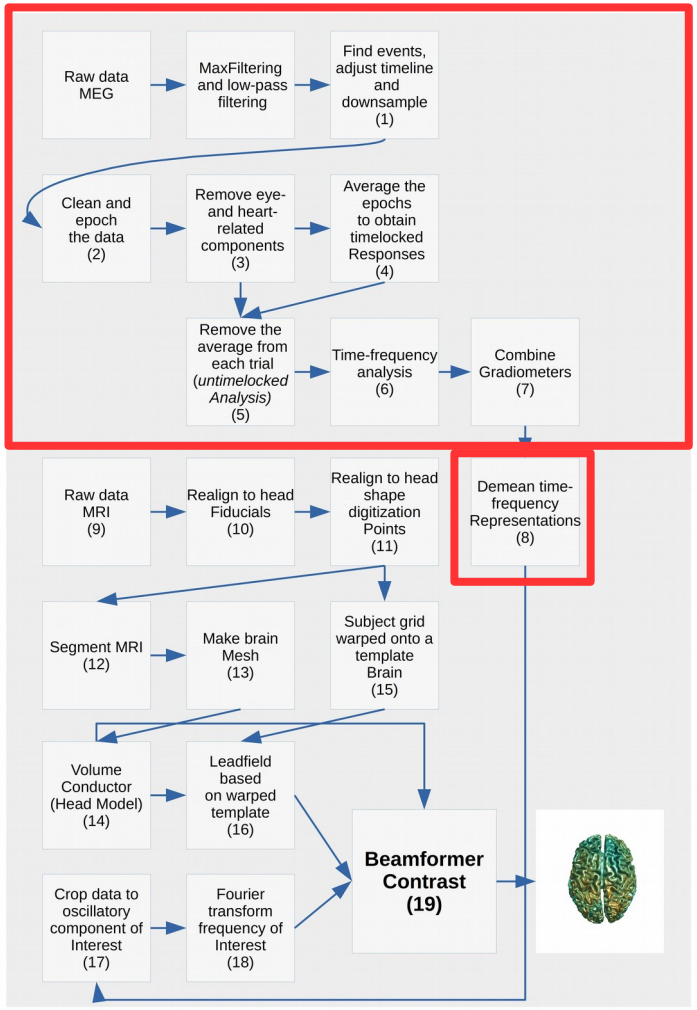

Adapted from: *Andersen, L.M., 2018. Front. Neurosci. 12.*

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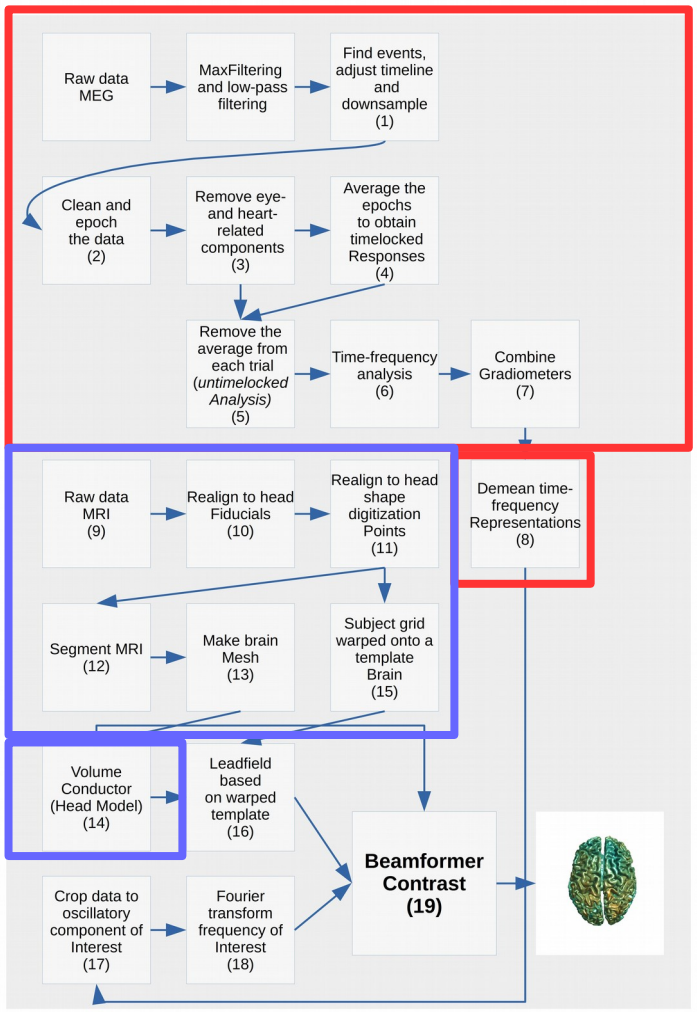
(Note that warping (15-16) is only needed if you are preparing the subject to part of a group analysis)



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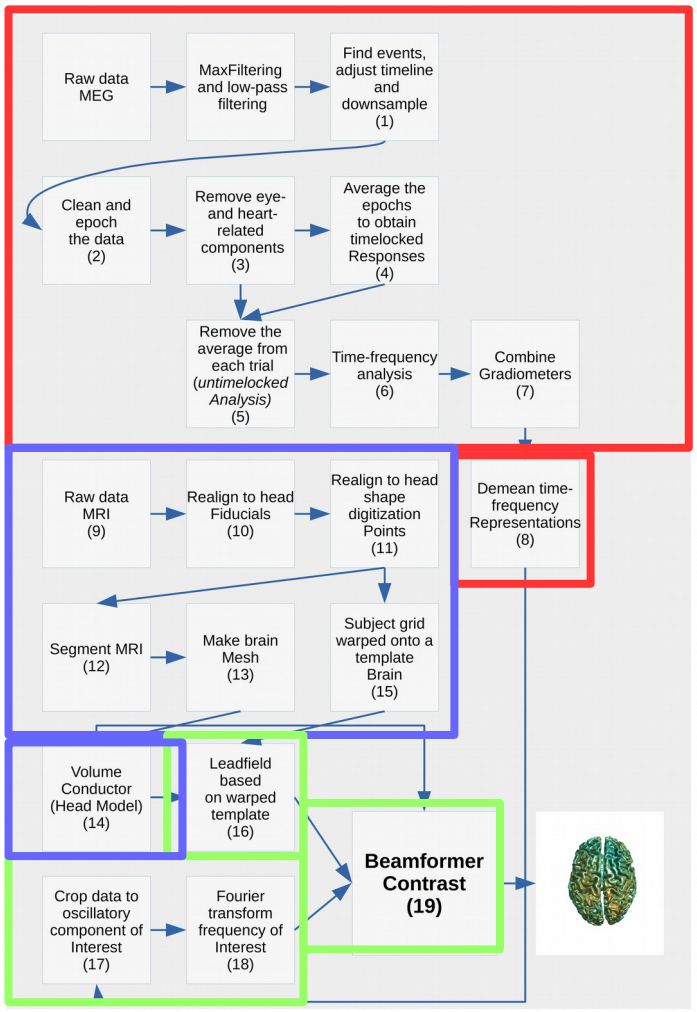


Adapted from: *Andersen, L.M., 2018. Front. Neurosci. 12.*

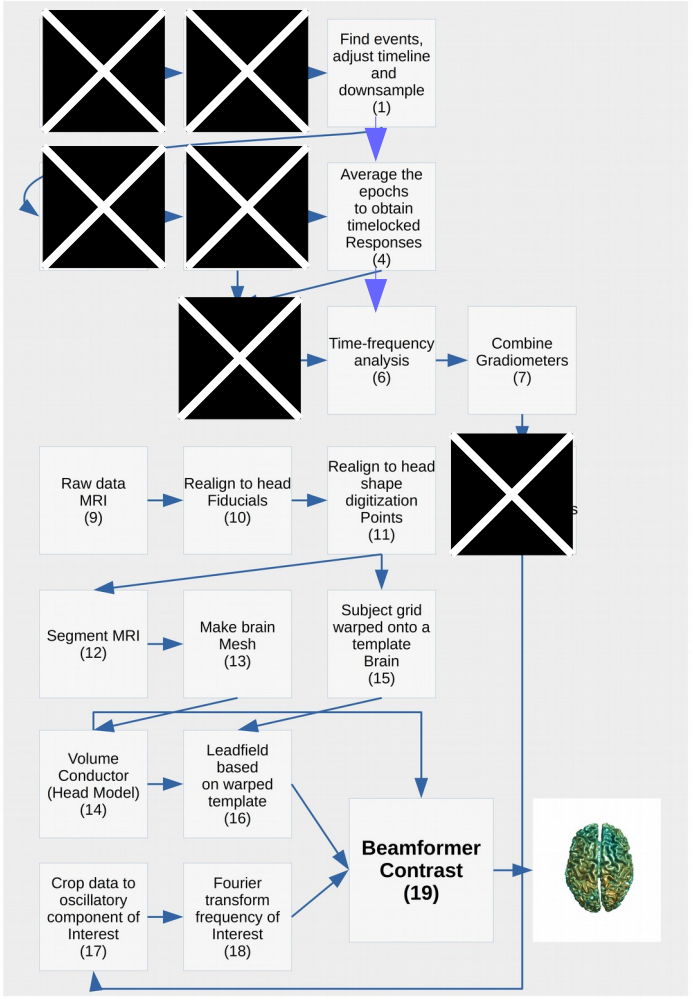
Steps covered today

Find events, adjust timeline and downsample (1)

Average the epochs to obtain timelocked Responses (4)

Time-frequency analysis (6)

Combine Gradiometers (7)



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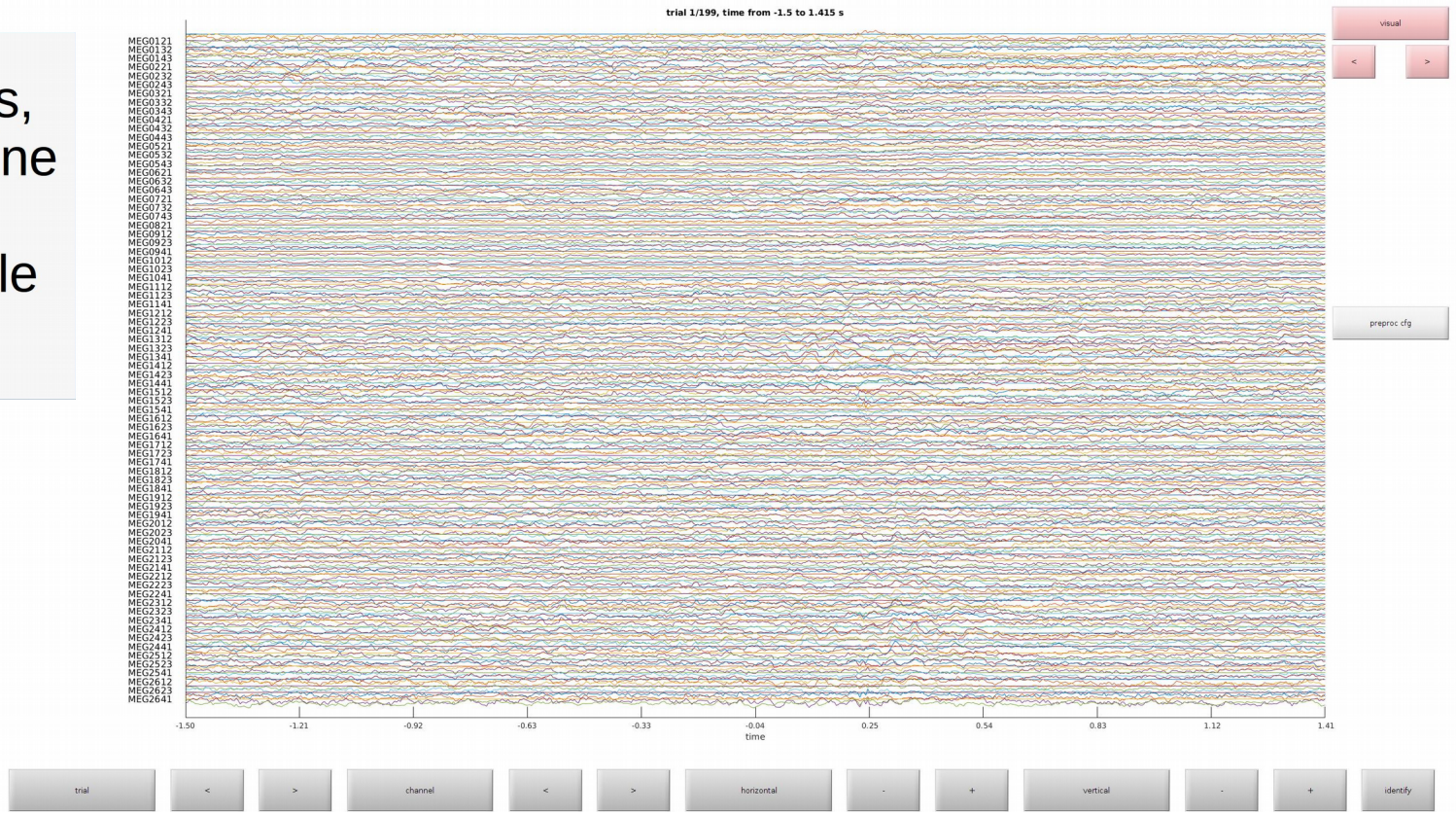

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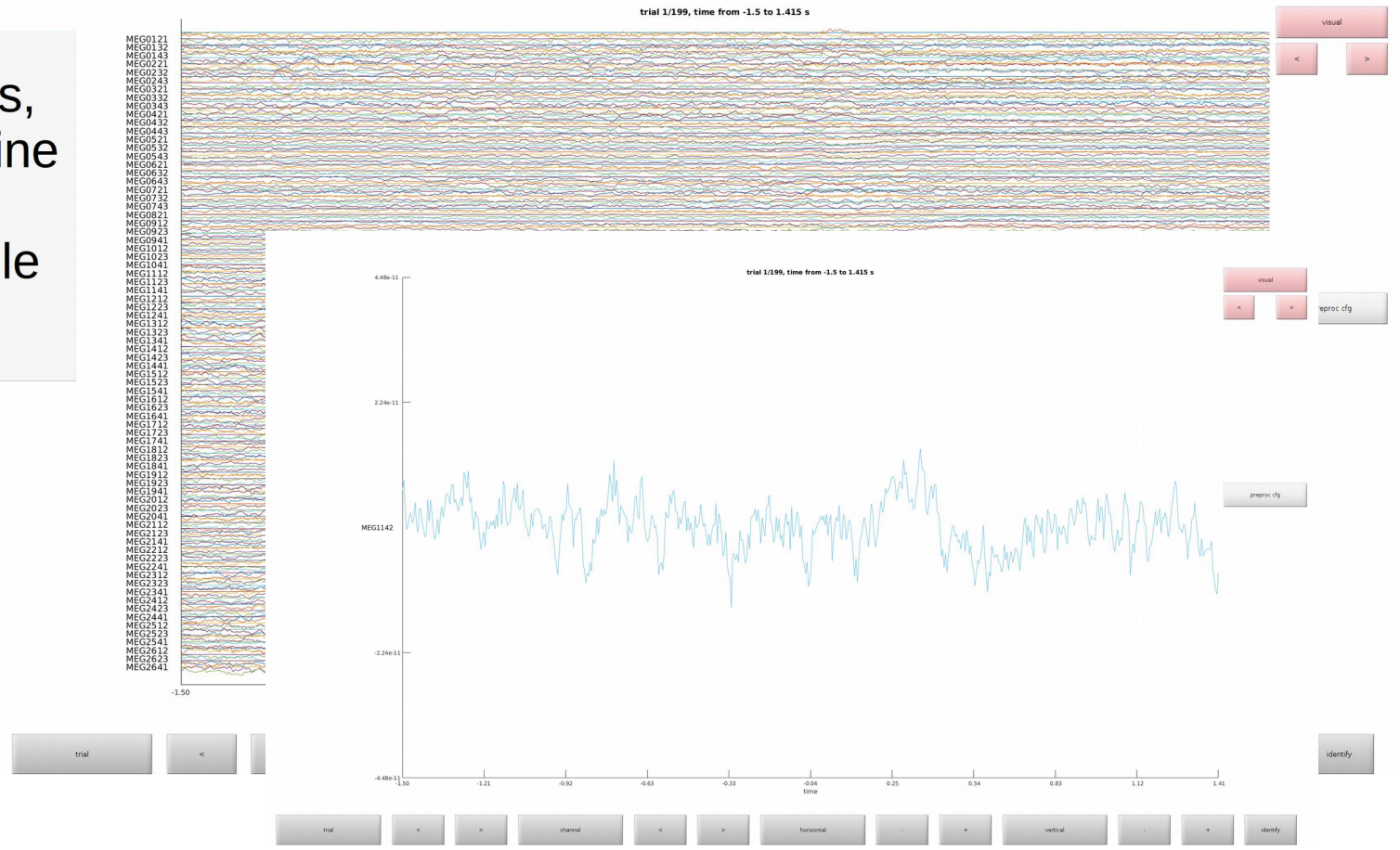
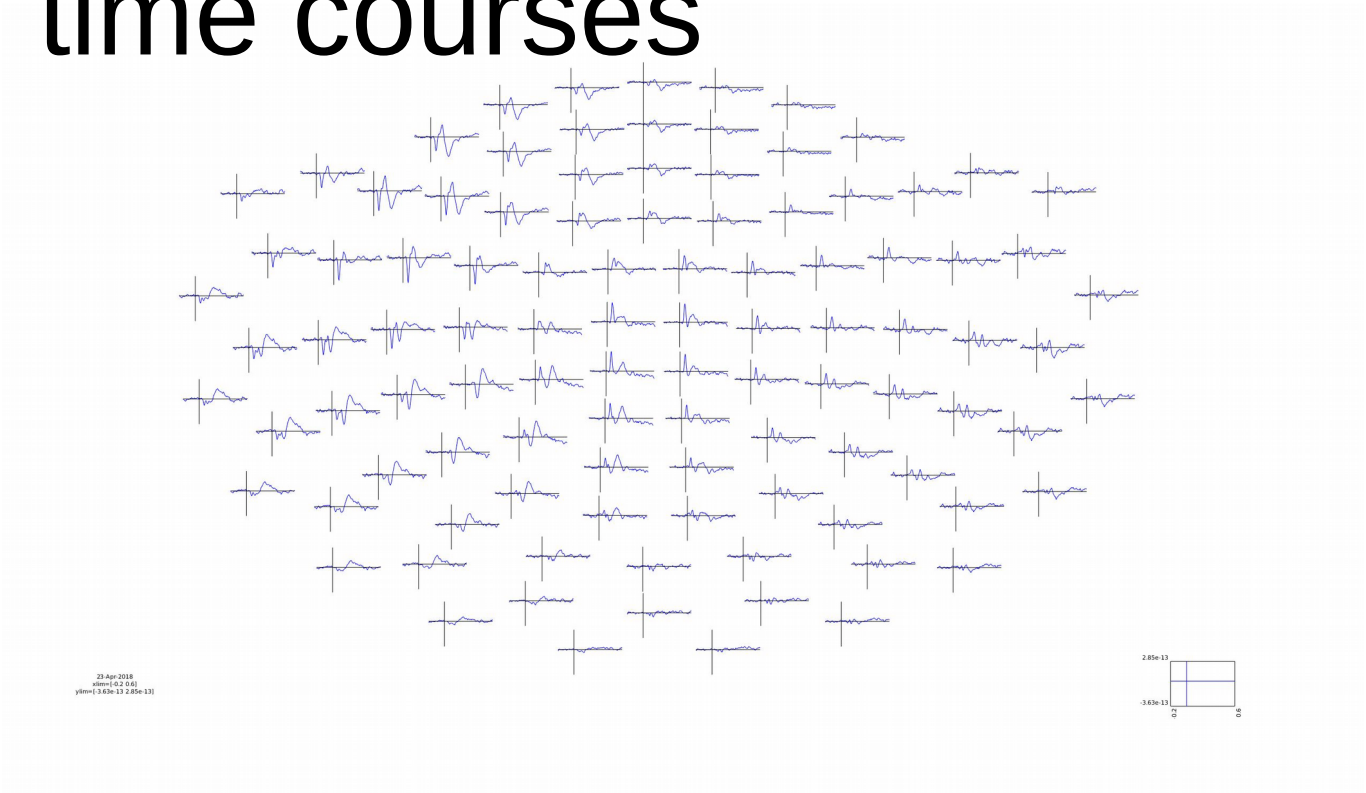


2D time courses

Average the epochs to obtain timelocked Responses (4)



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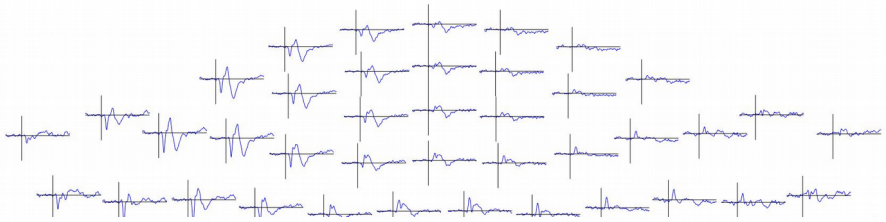
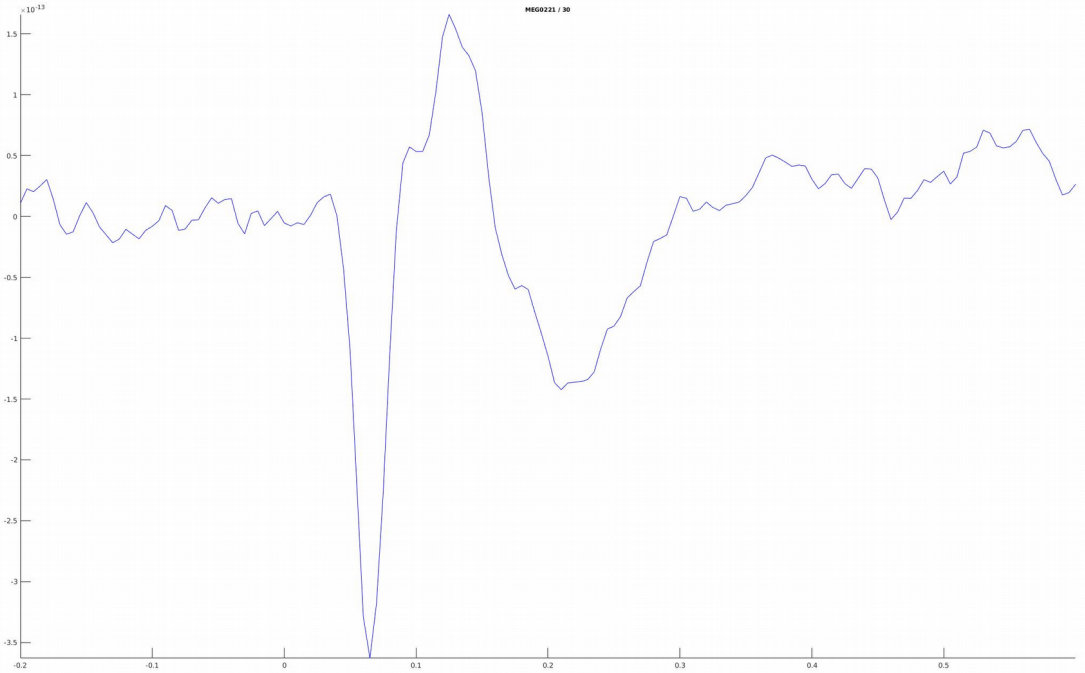
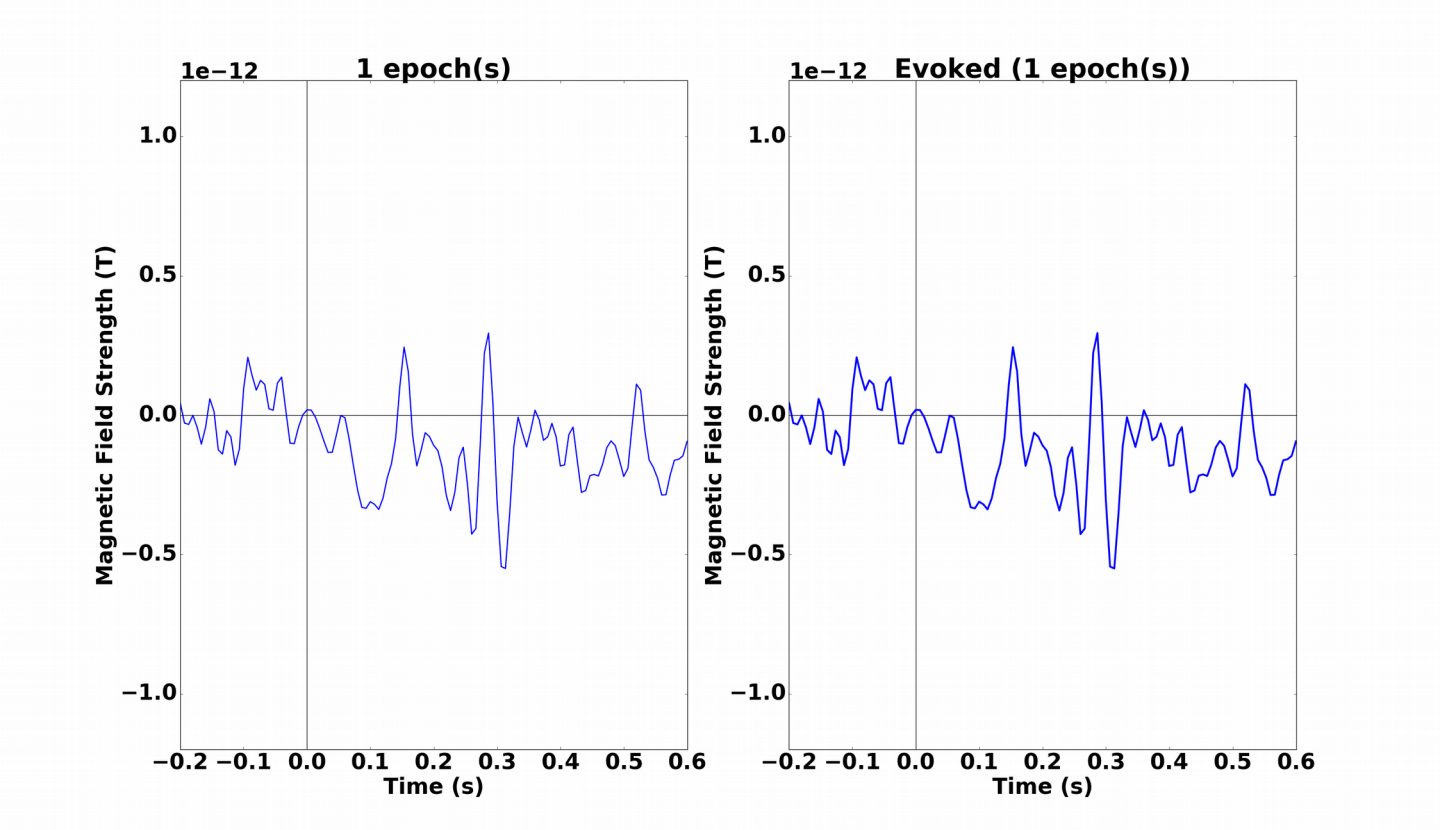
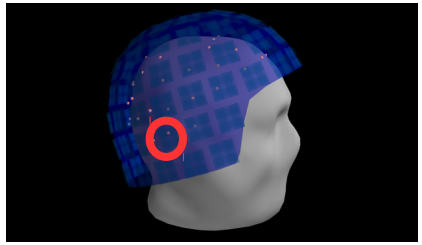




Epochs and Evoked (MEG)





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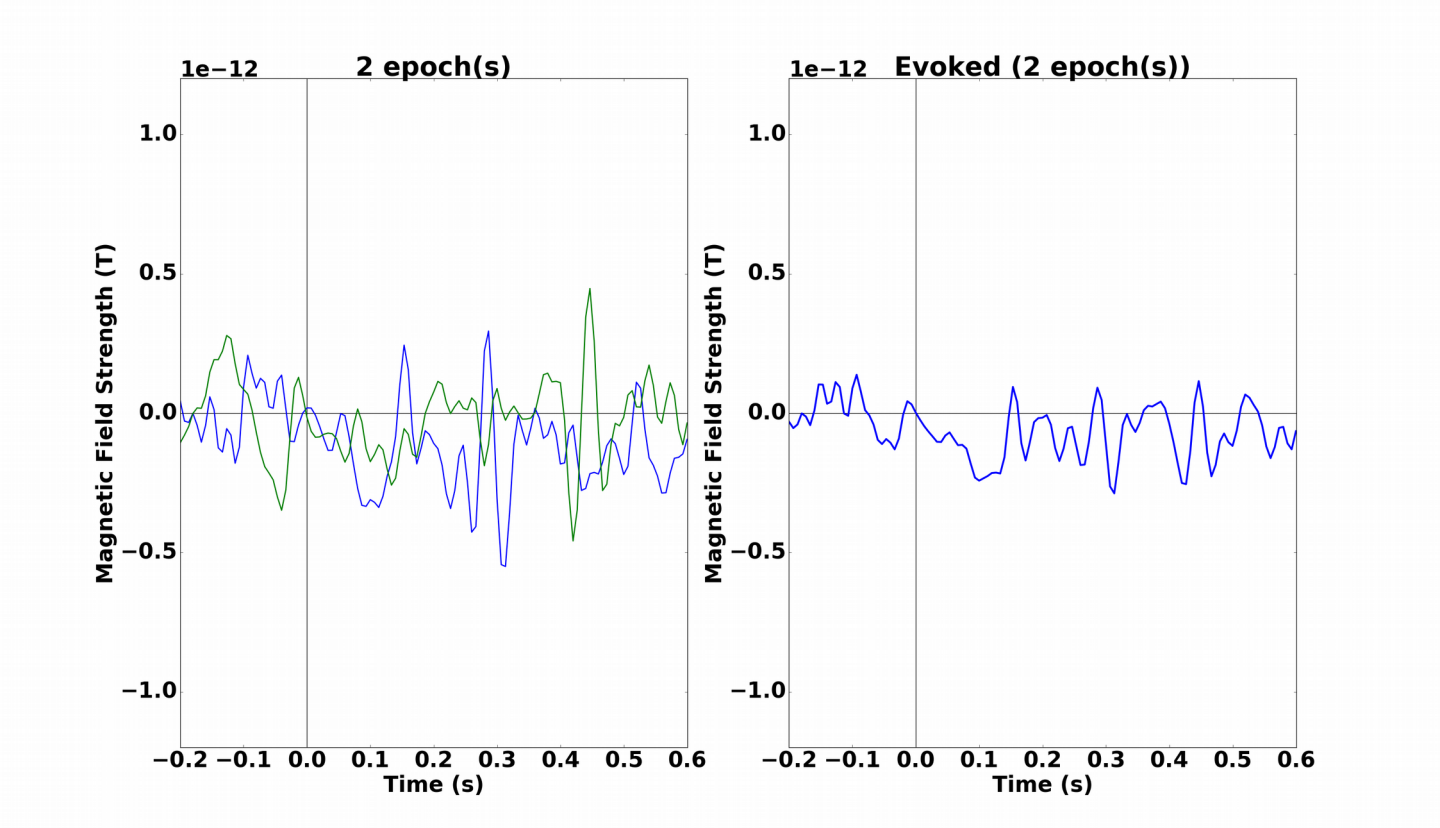

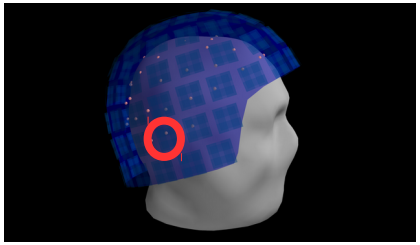

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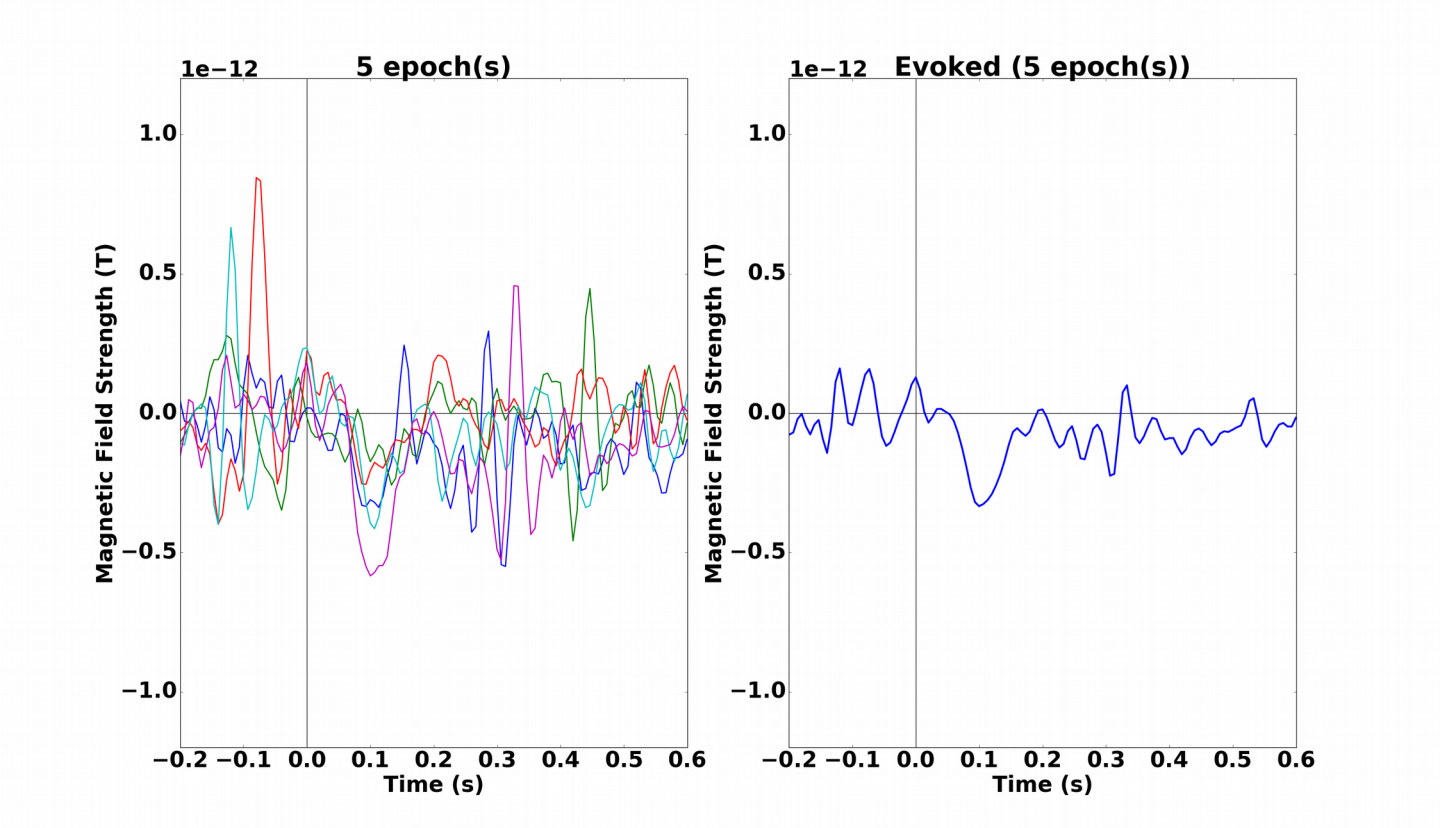

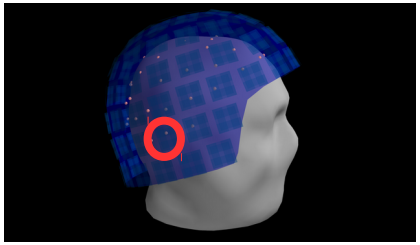

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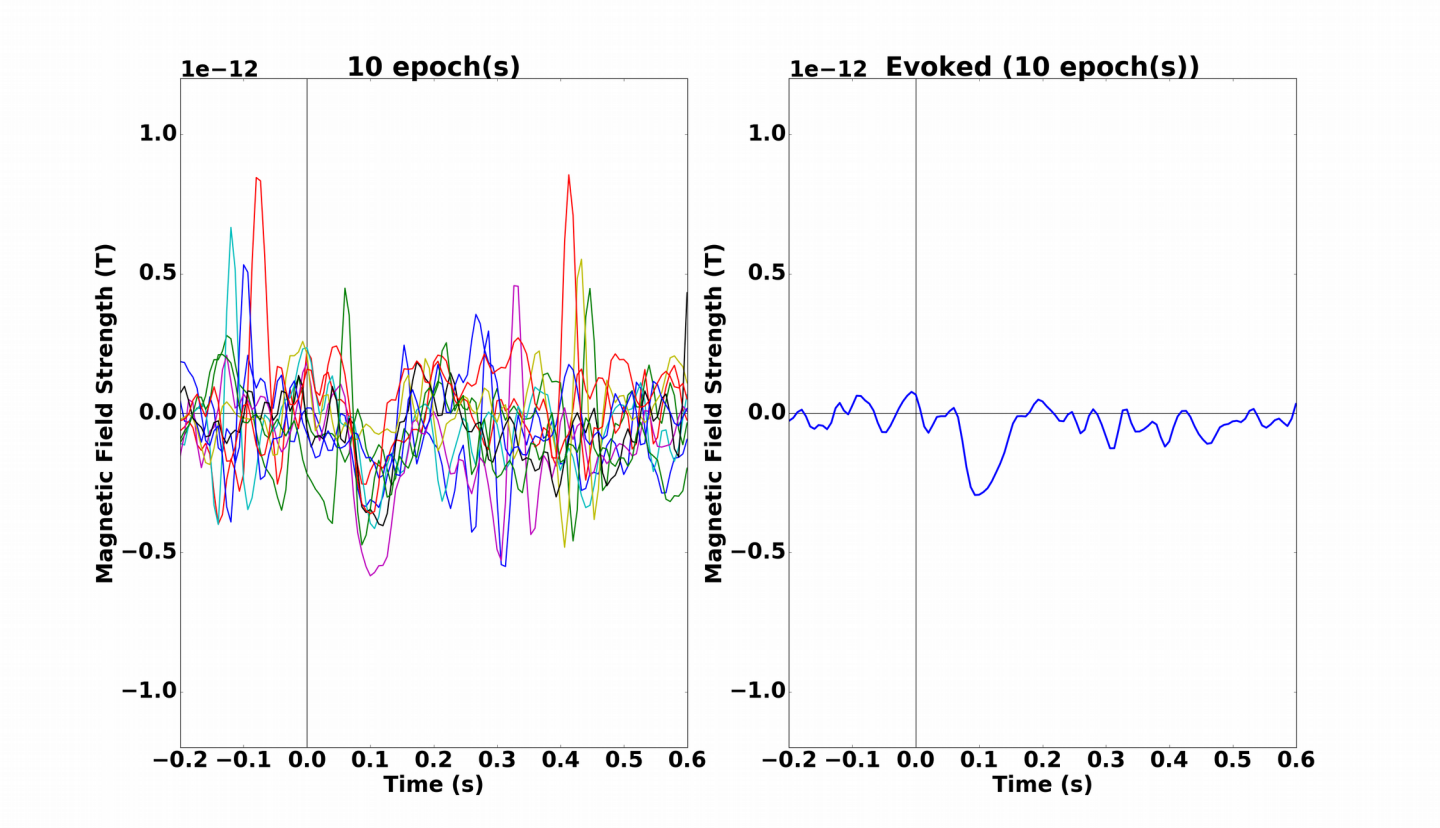

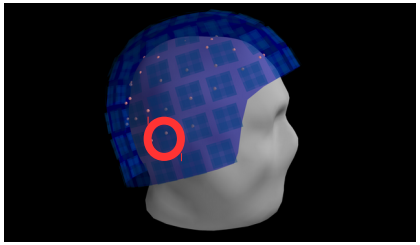

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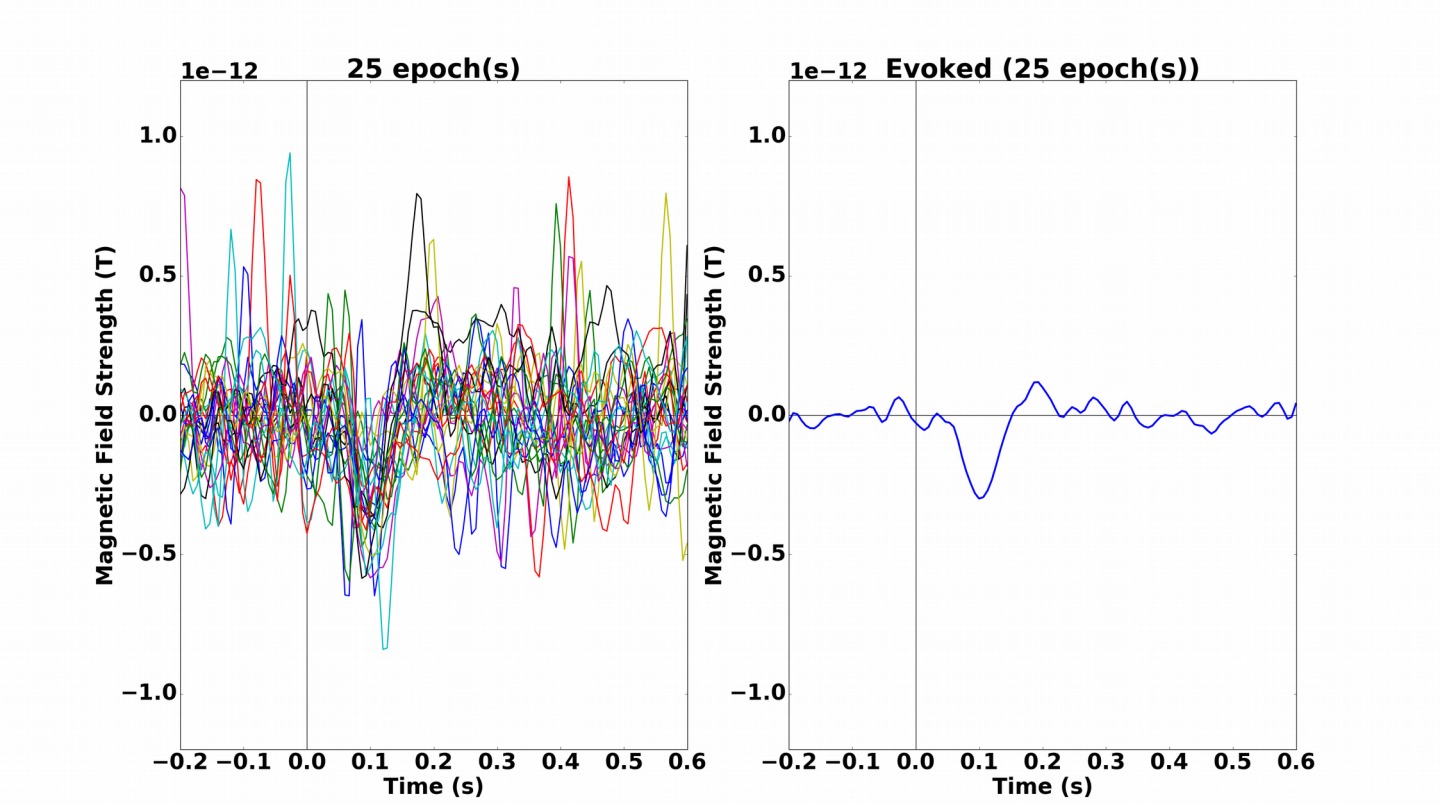

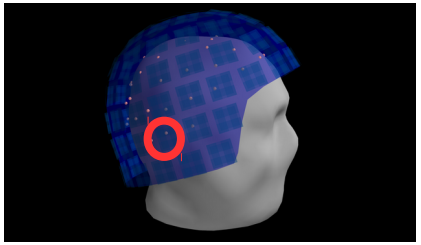

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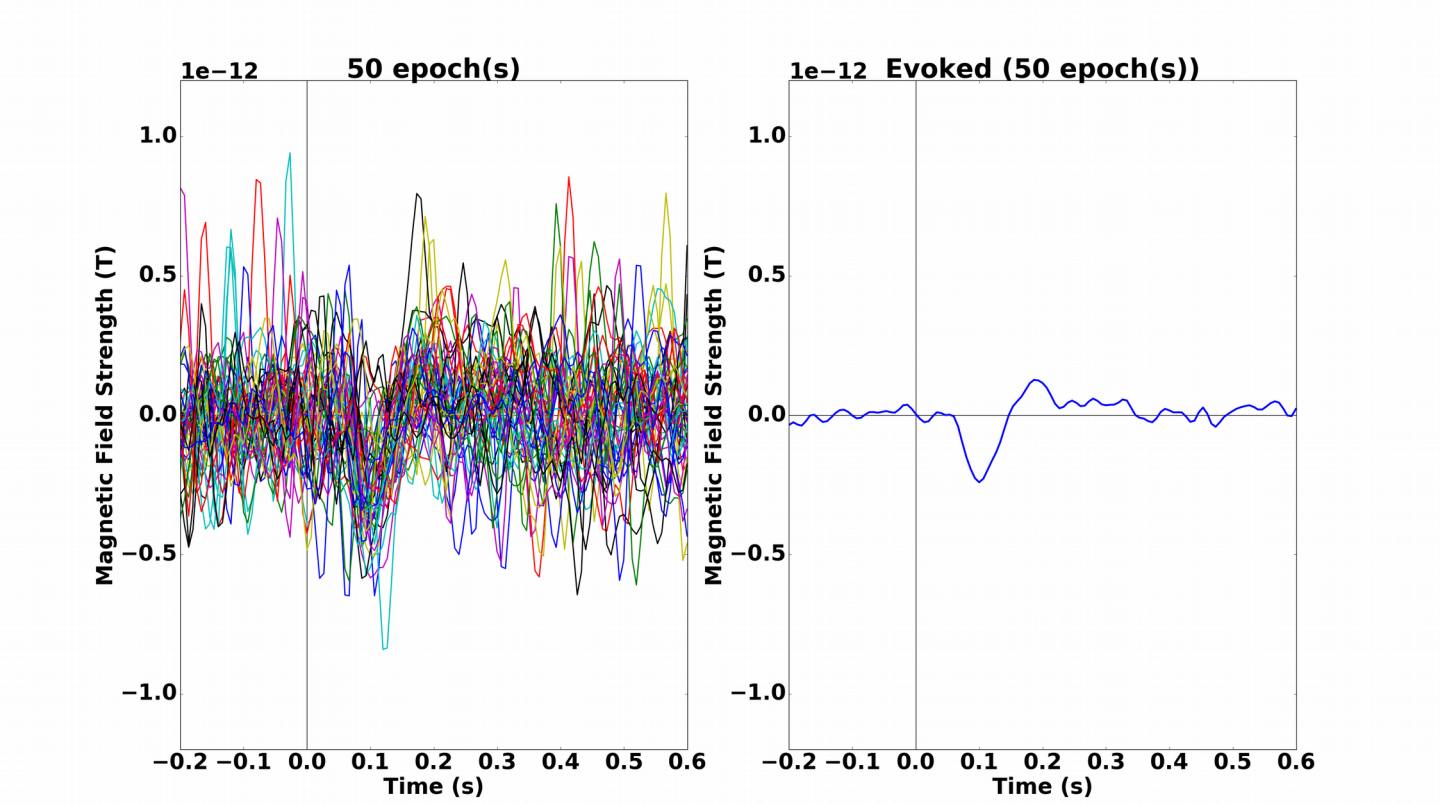

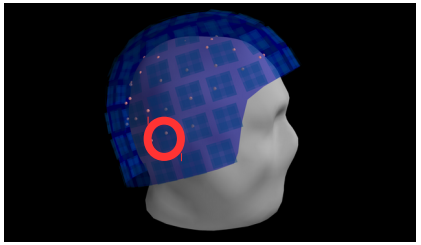

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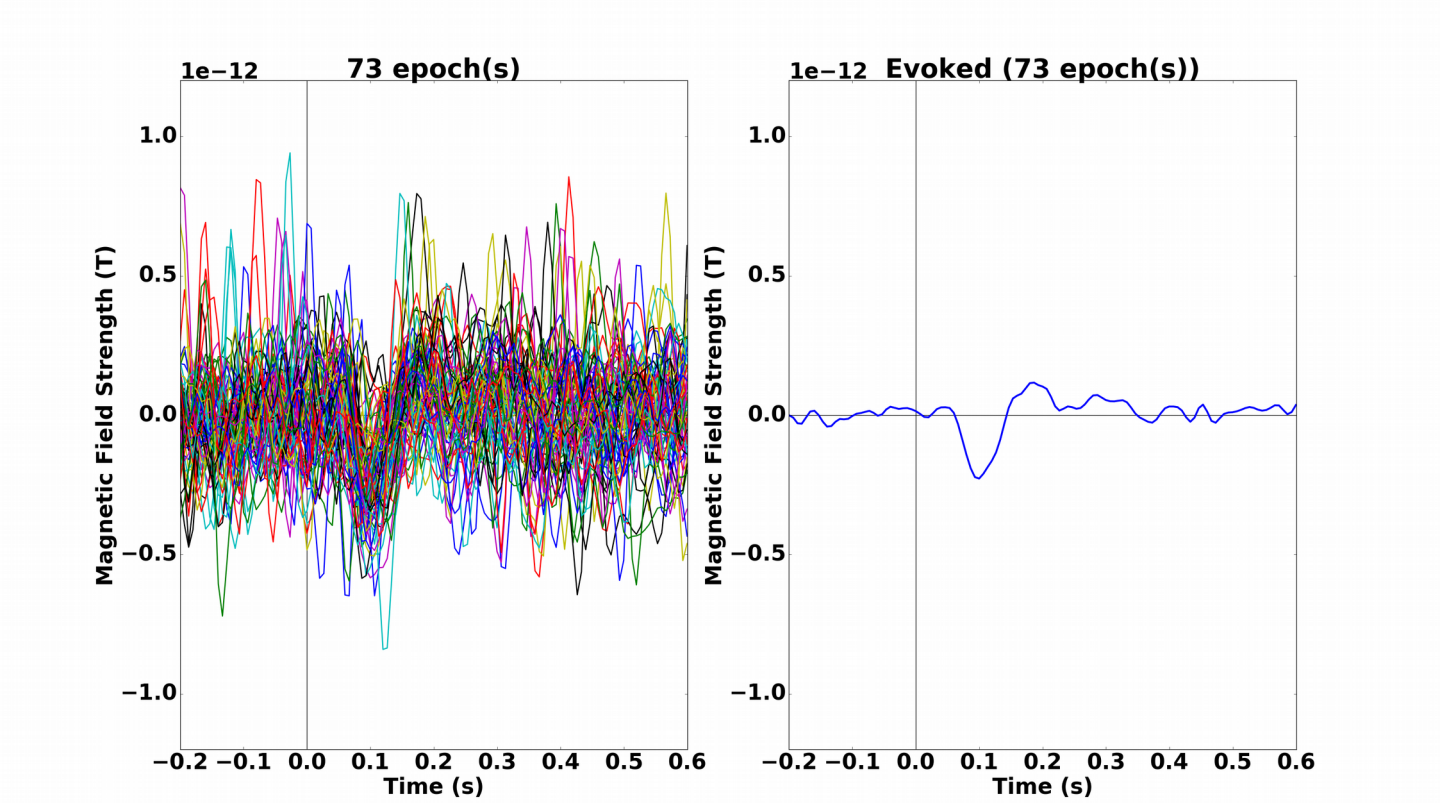
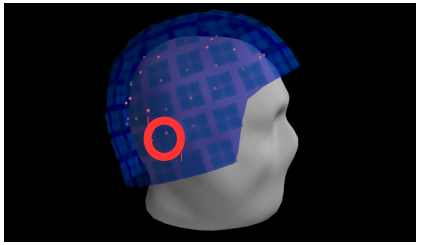
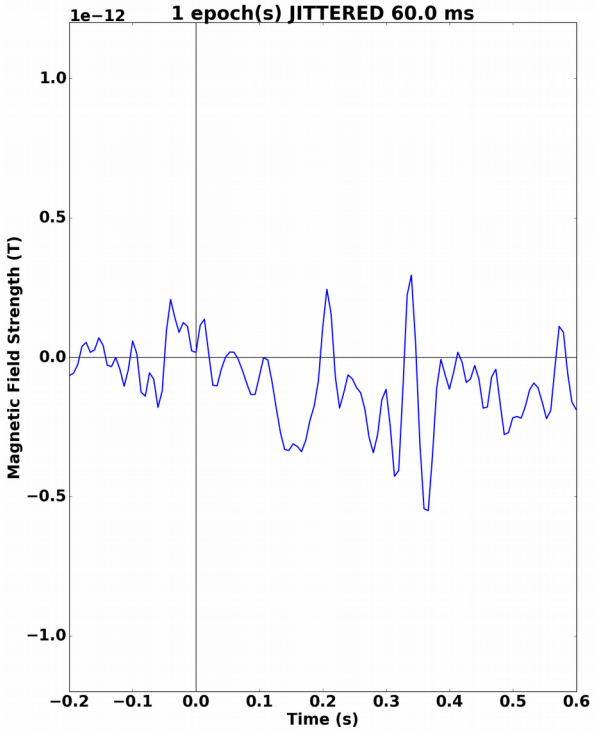
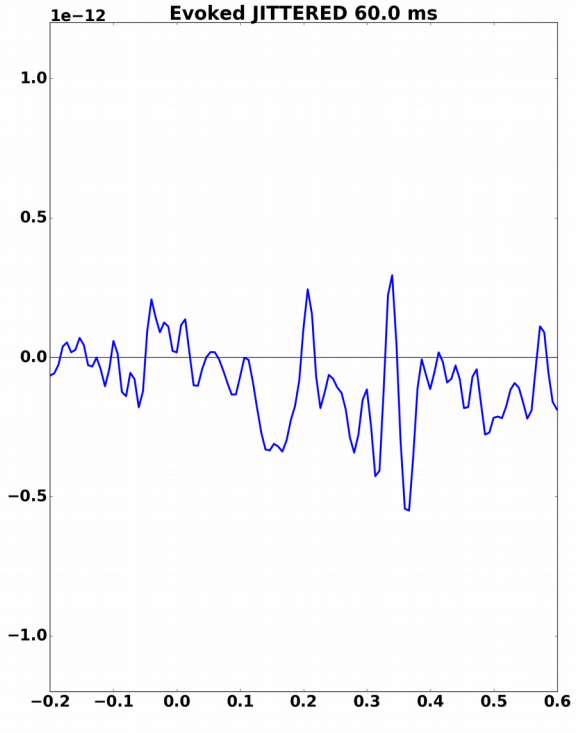
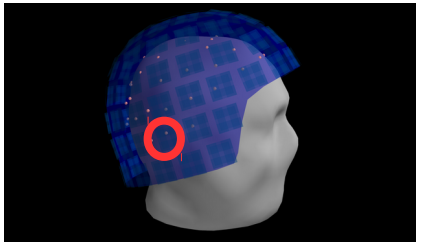




Epochs and Evoked JITTERED 60 ms (MEG)







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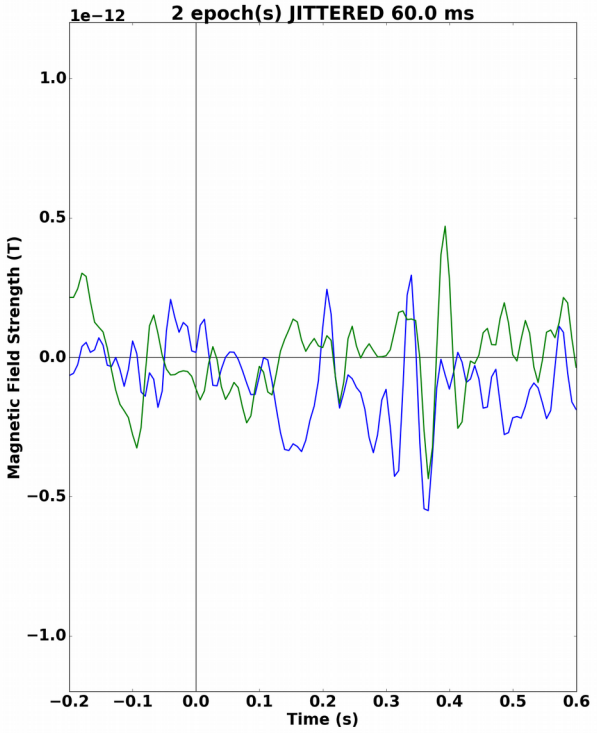

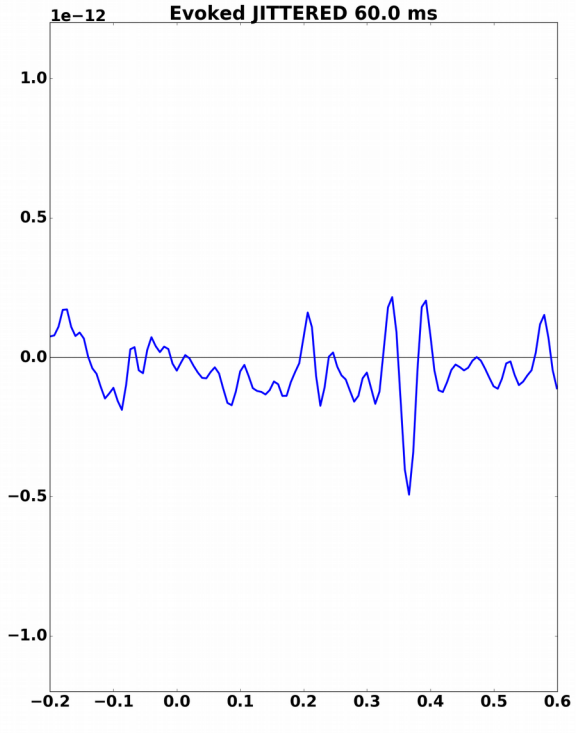

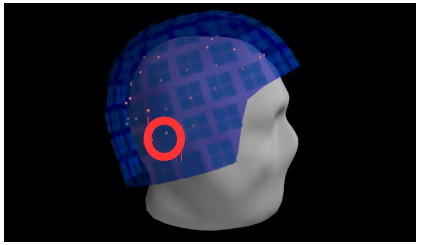

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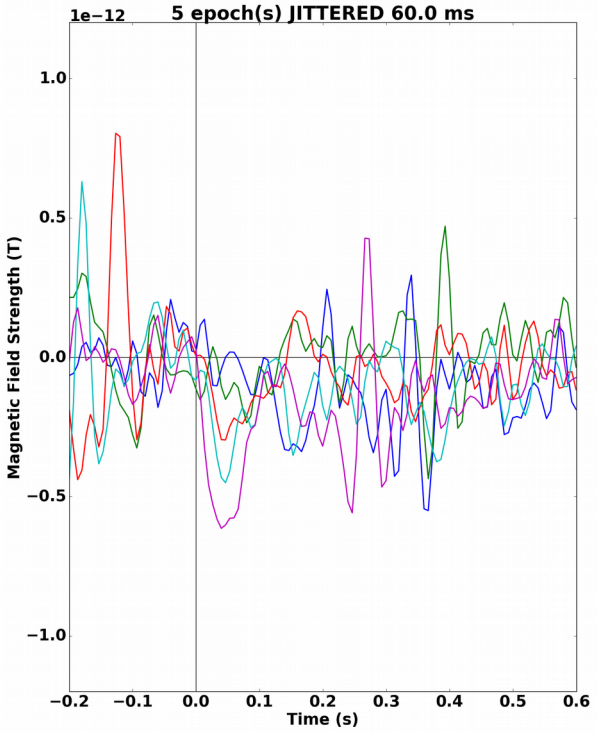

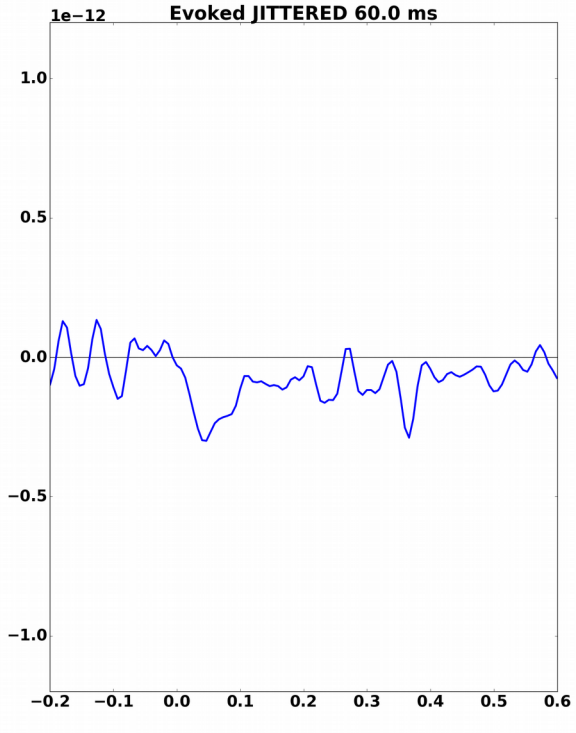

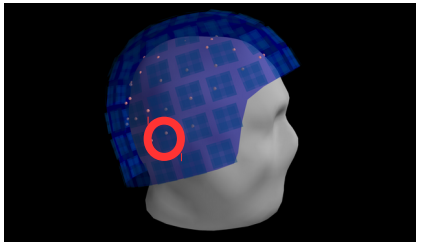

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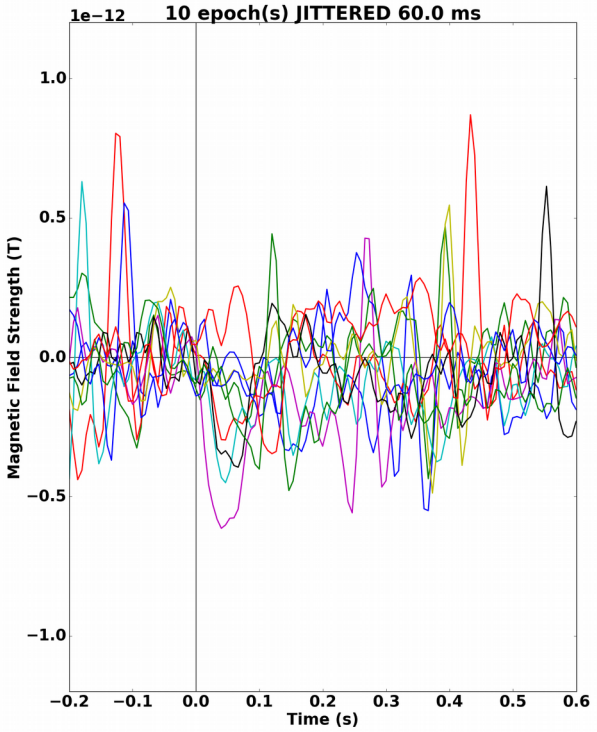

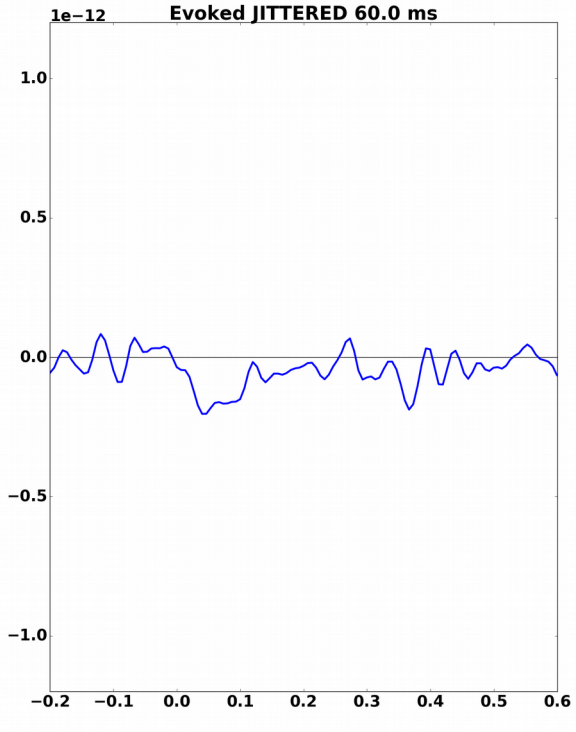

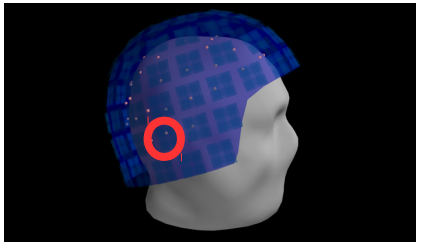

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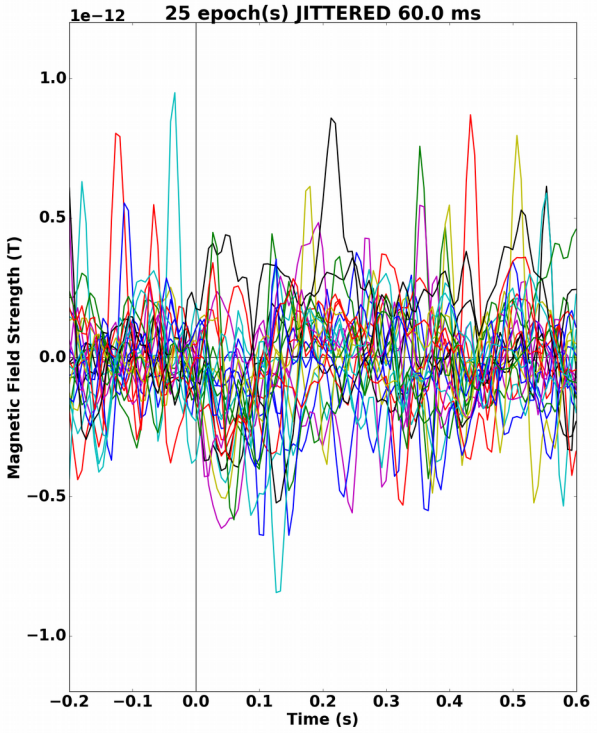

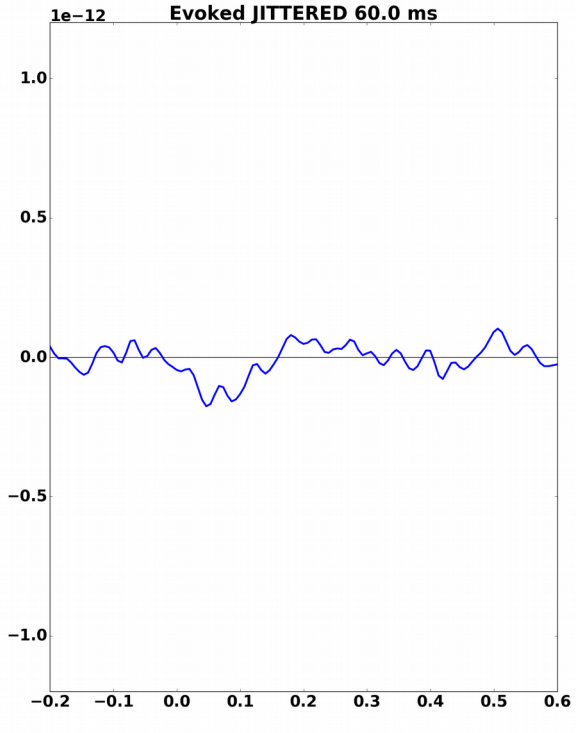

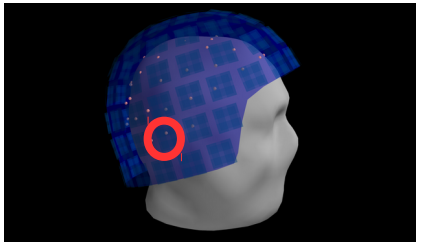

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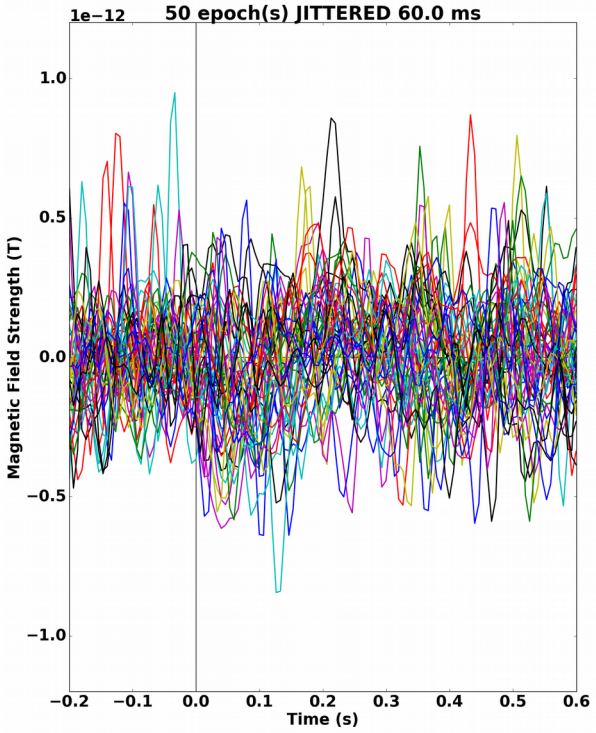

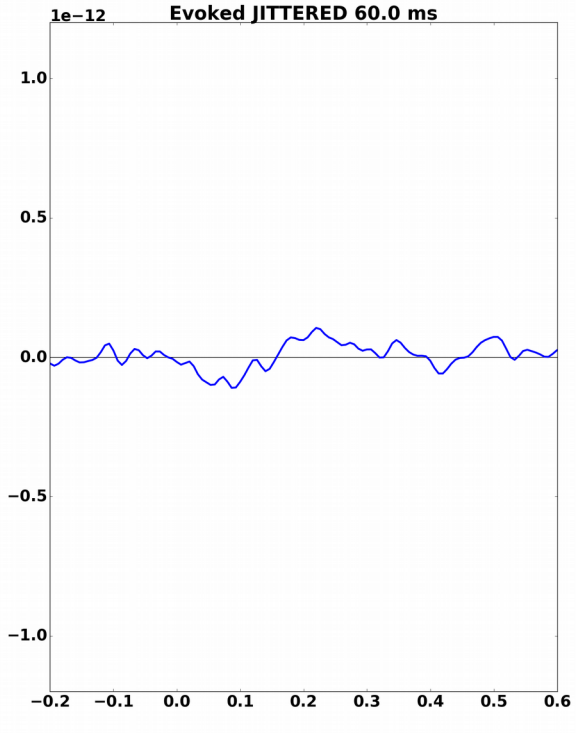

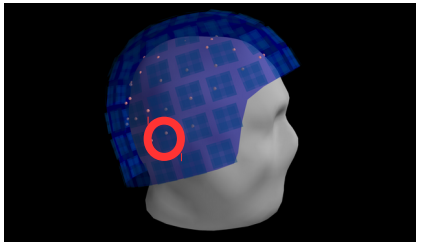

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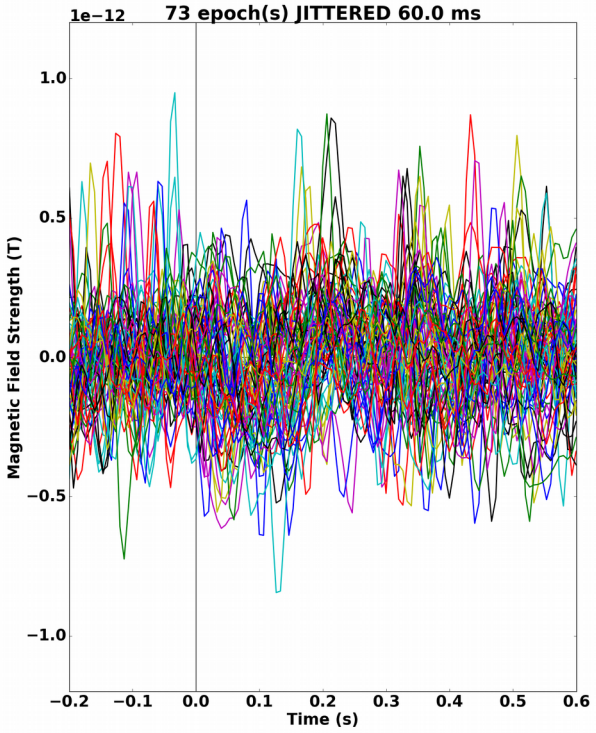
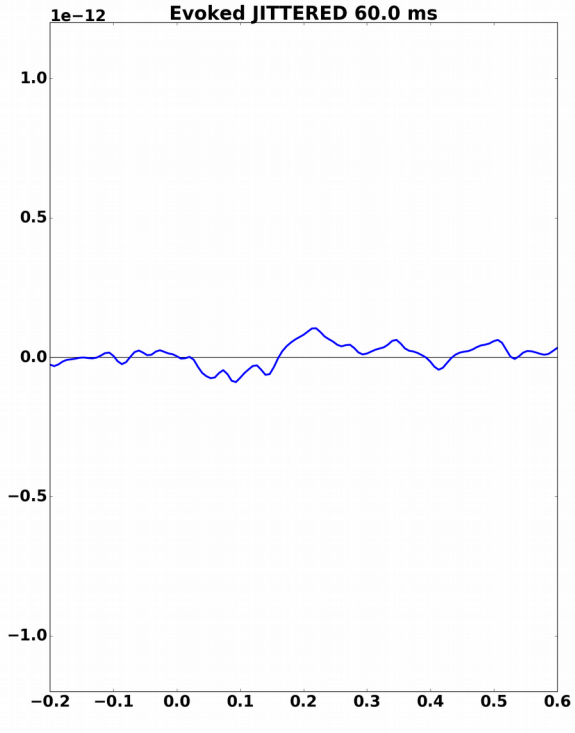
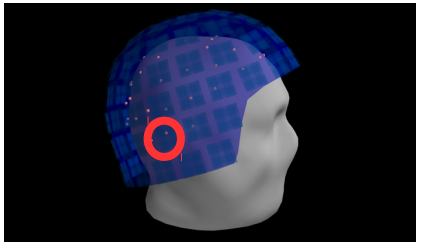
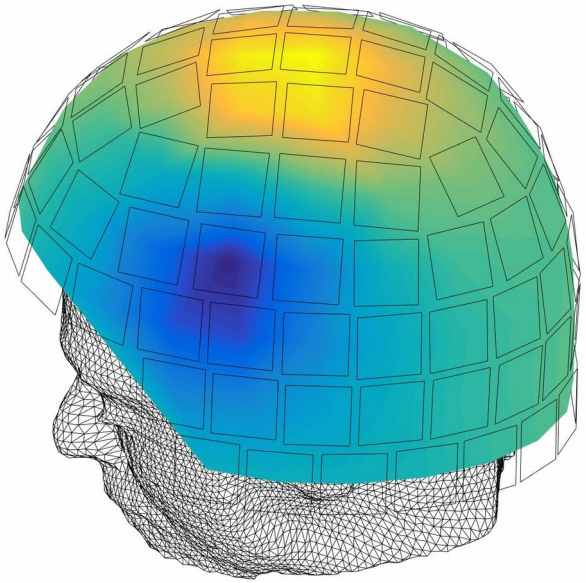
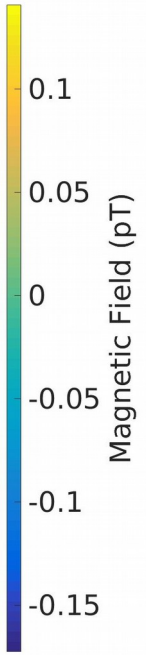




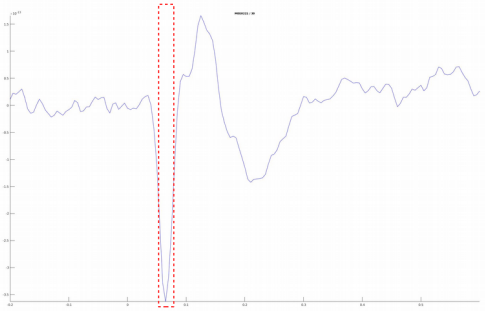


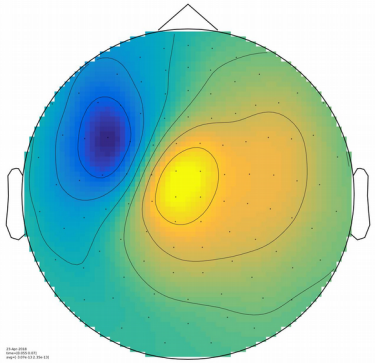
Topographies





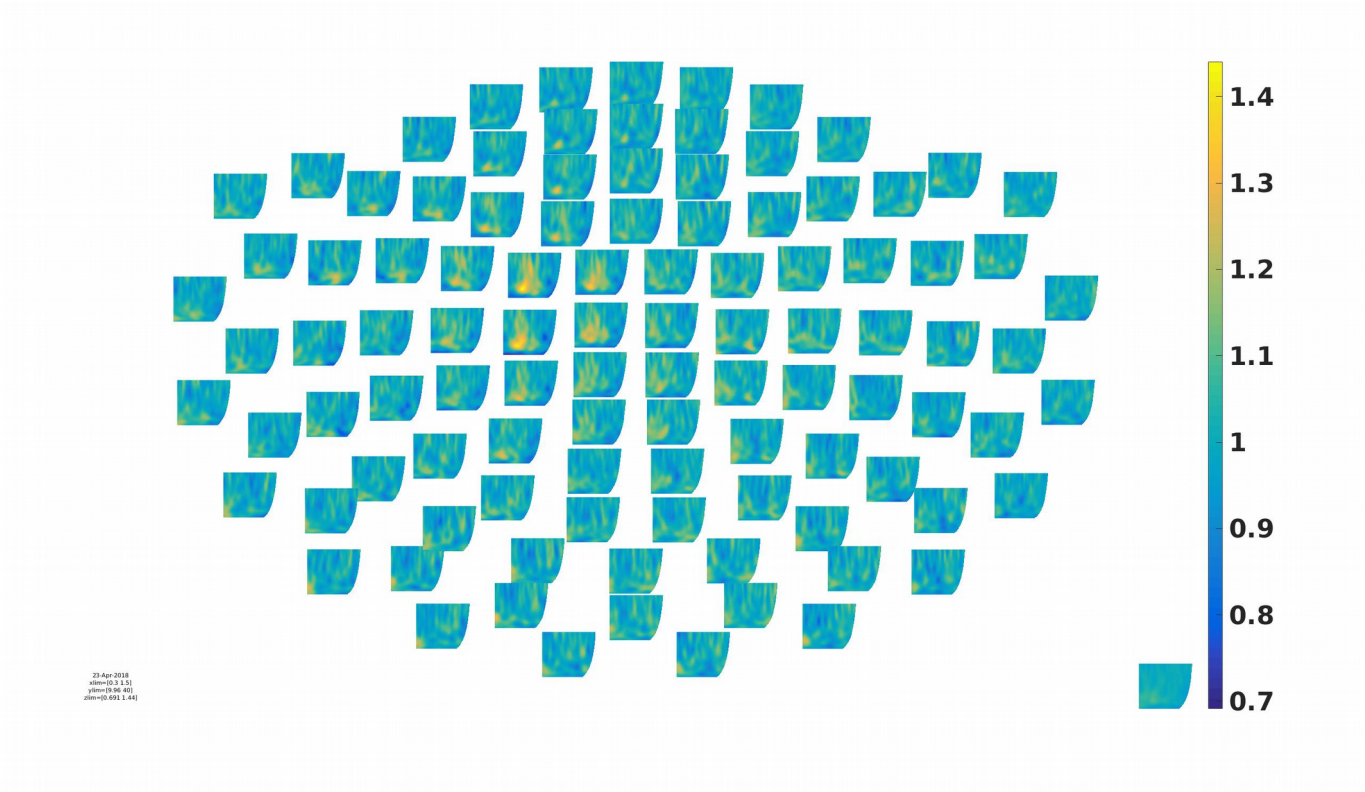
55 ms





Time-frequency analysis (6)

Combine Gradiometers (7)



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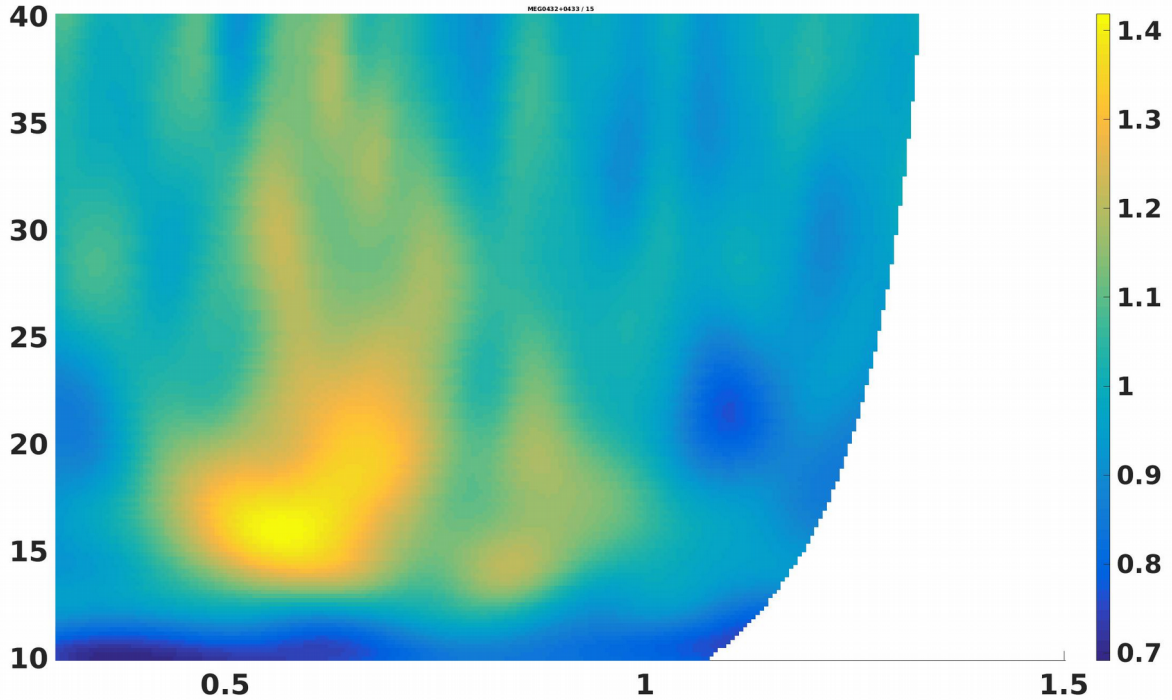
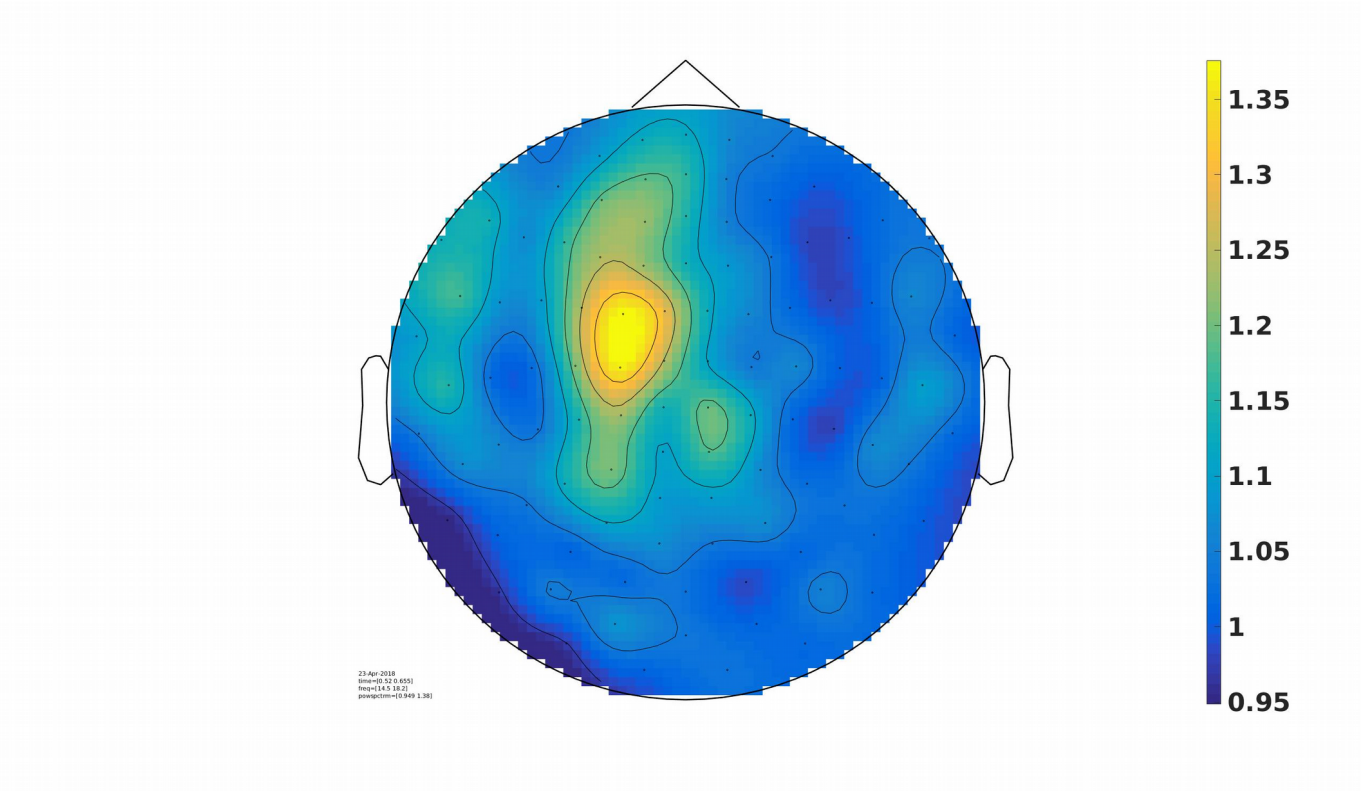


Time-frequency analysis (6)

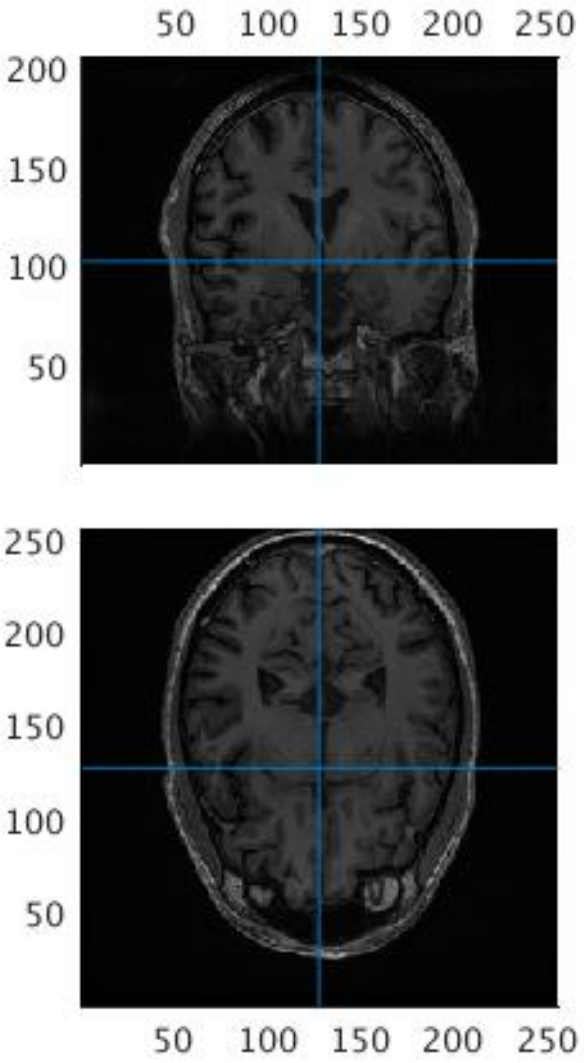
Combine Gradiometers (7)

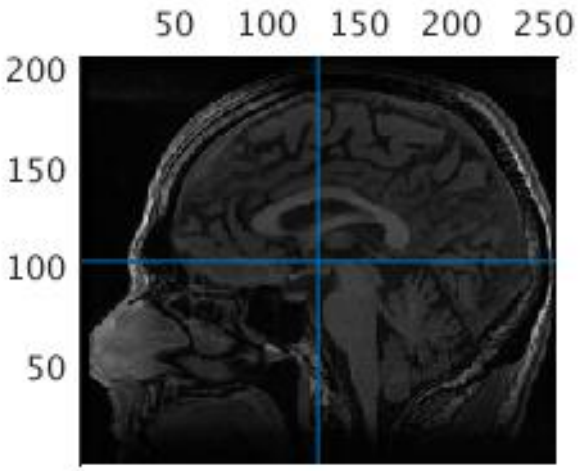
Time: 500-600 ms
Frequency: 14-18 Hz



Preprocess MR data

Raw data
MRI
(9)

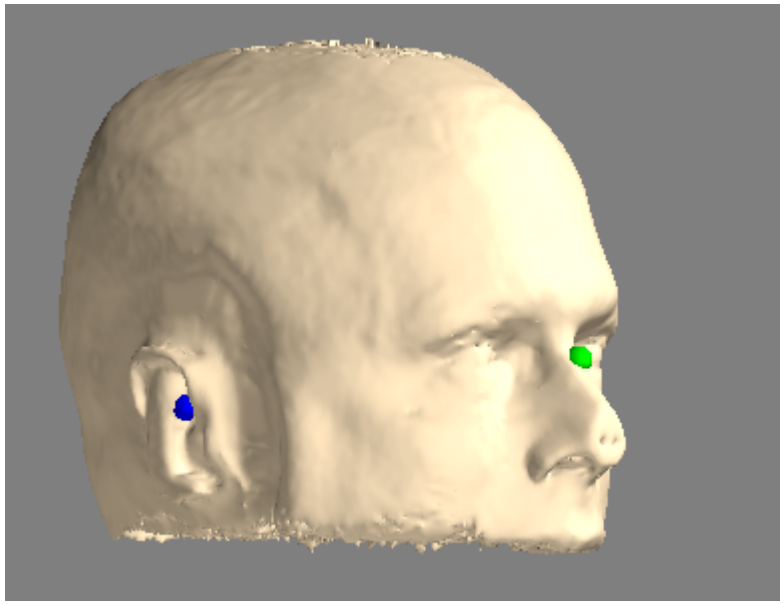


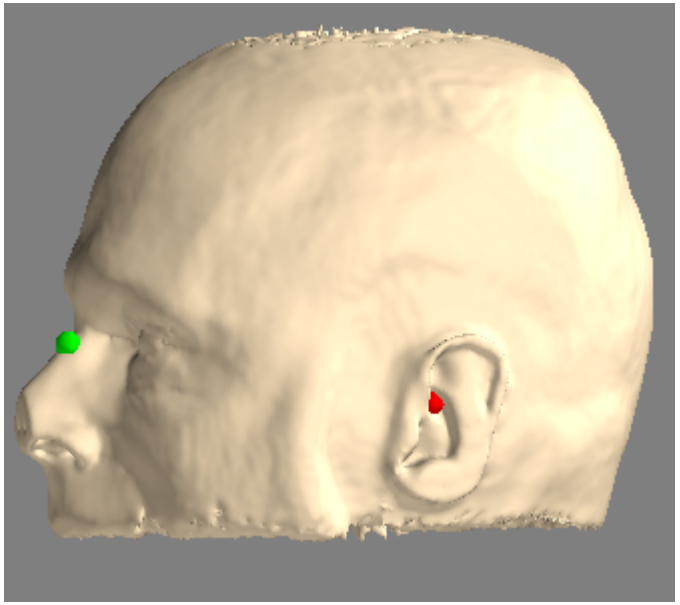


voxel 6717312, indices [128 128 103]
acpc coordinates [2.2 46.2 -1.0] mm

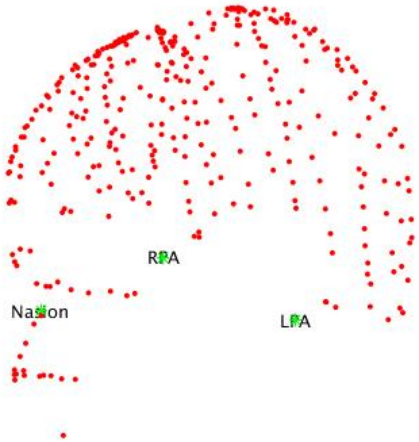
atlas label: NA

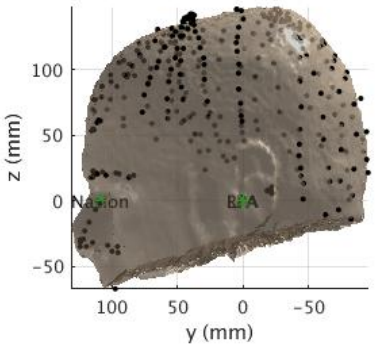
Realign to head Fiducials (10)

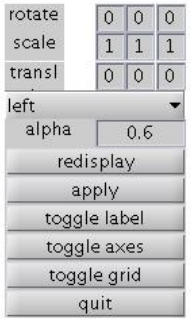




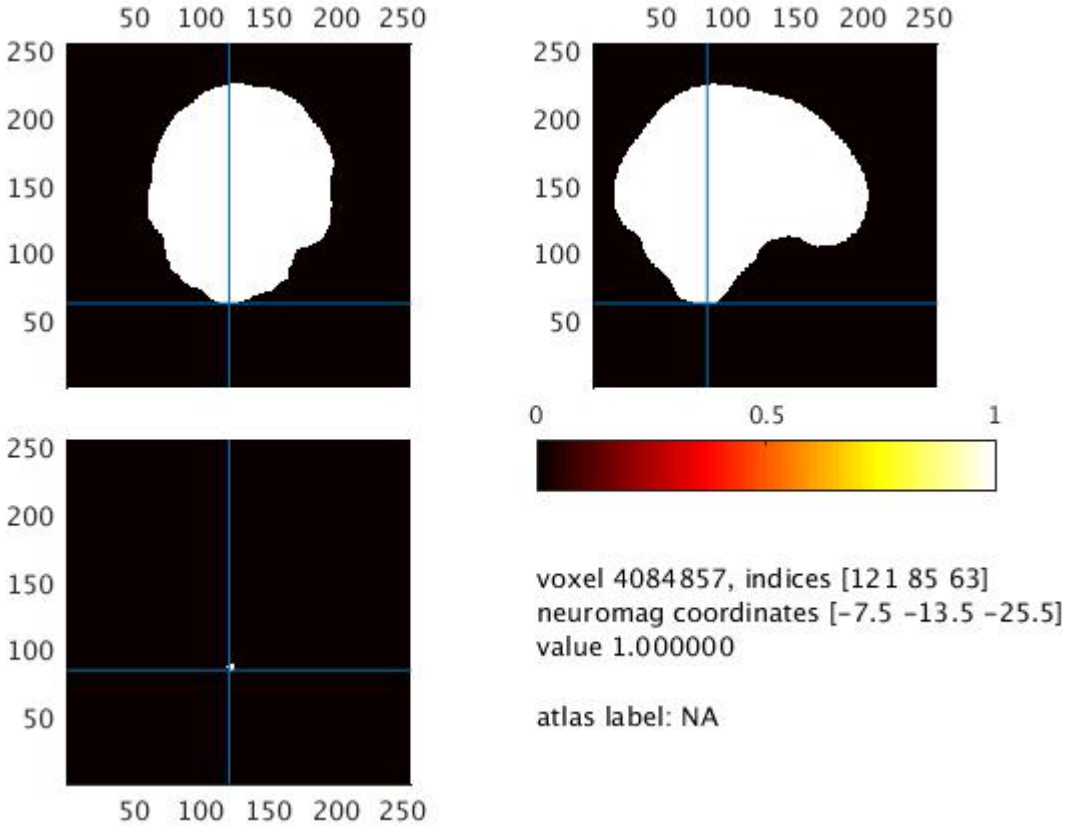
Realign to head shape digitization Points (11)



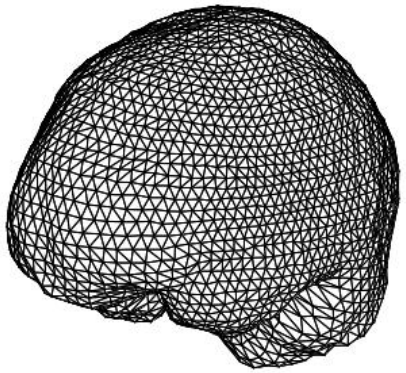




Segment MRI (12)

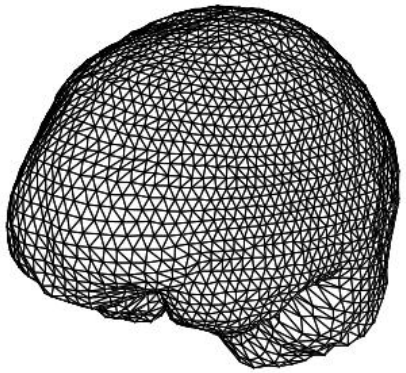


Make brain Mesh (13)



Volume Conductor (Head Model) (14)

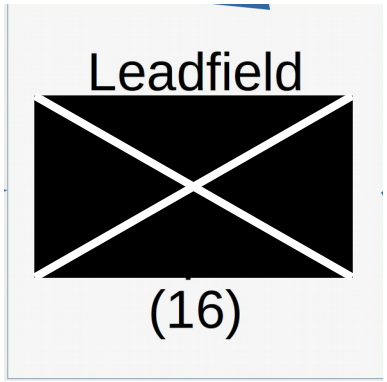
This specifies how the electric currents spread throughout the conductor (the brain compartment inside the skull).



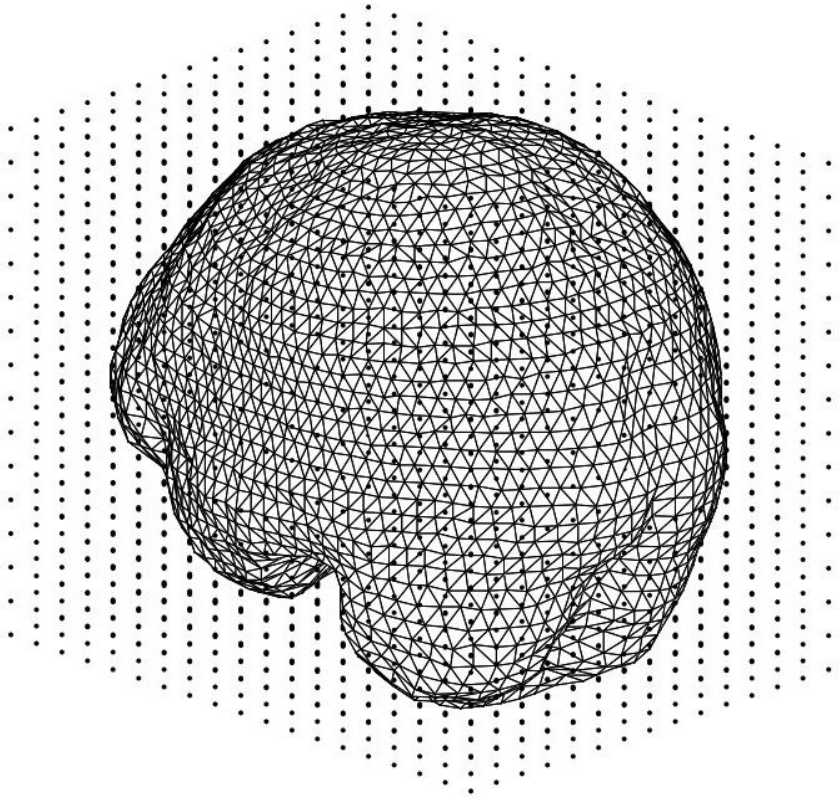
Source analysis (beamformer)

Leadfield based on warped template (16)

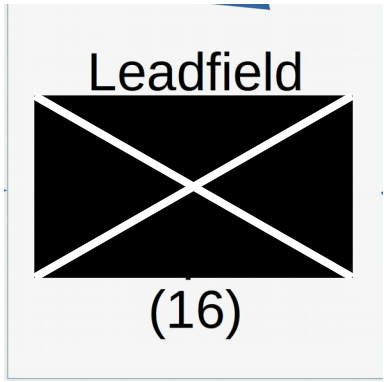
Leadfield



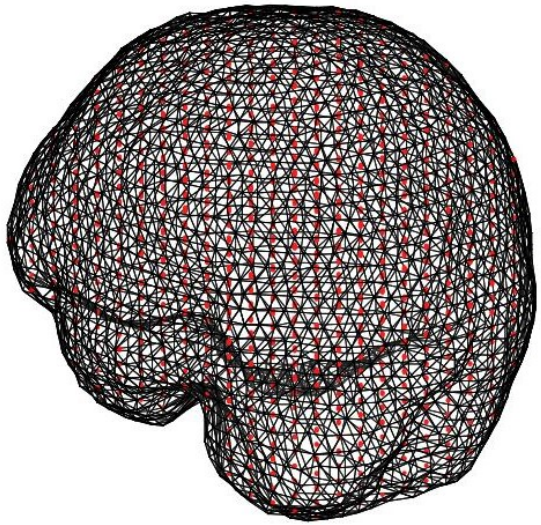
(16)



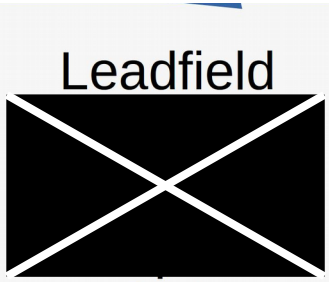
Leadfield



(16)

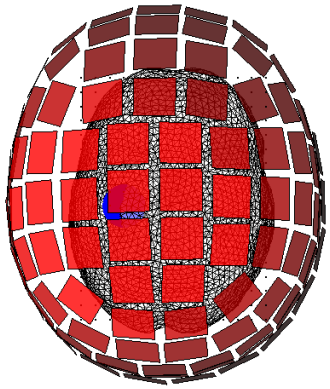


Leadfield

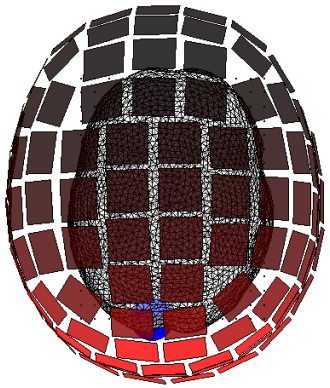


(16)

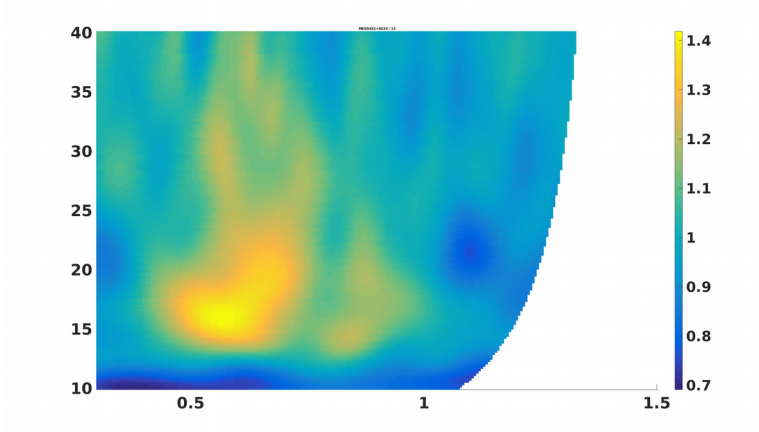
"Tactile source"



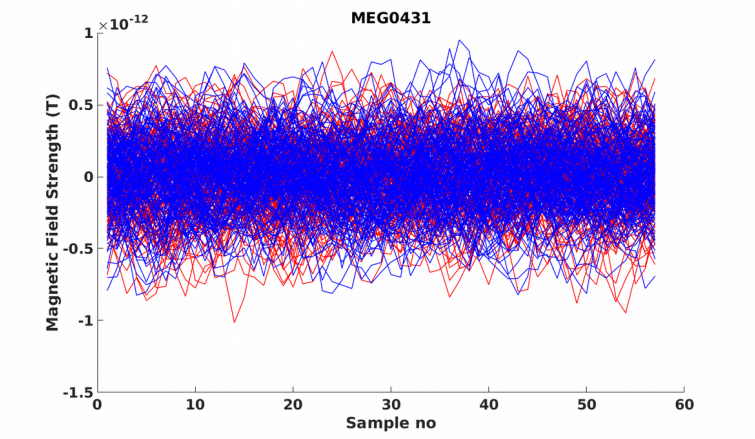
"Occipital" source



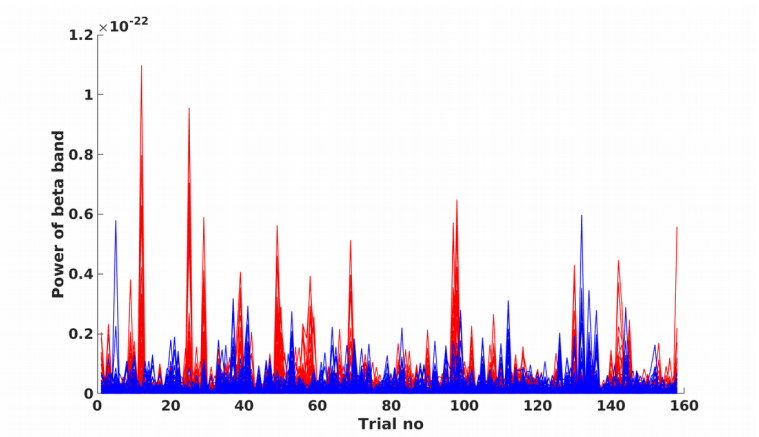
Crop data to oscillatory component of Interest (17)



Timelocked (average per sample)

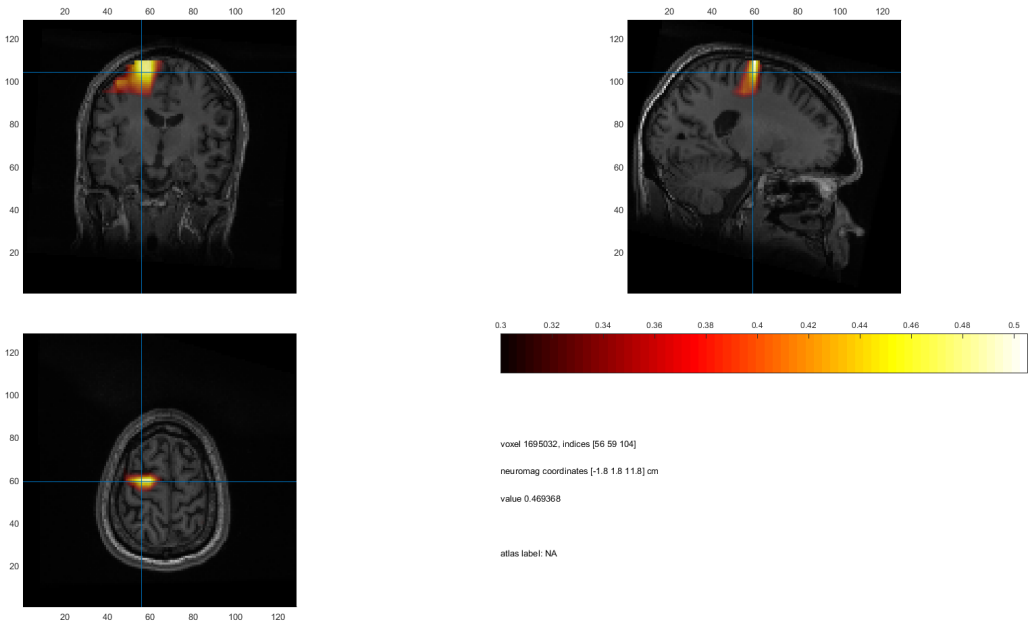


Power in the beta band (estimate per trial)



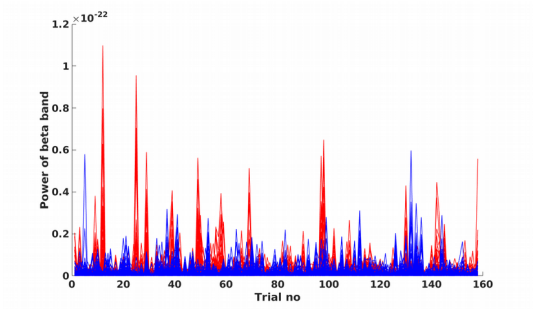
RED: rebound
BLUE: baseline

Beamformer Contrast (19)

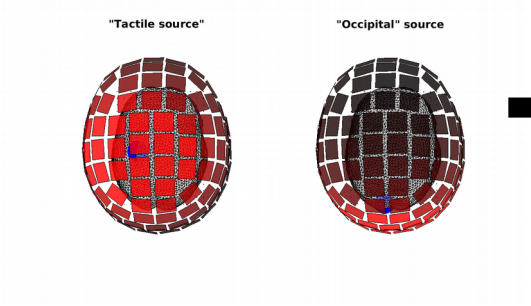


Frequency power estimates

Leadfield
(Linking all sources to all sensors)



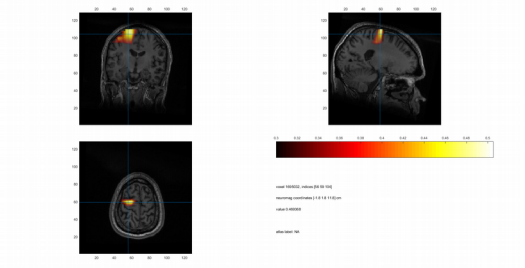
+



+ *MATH*

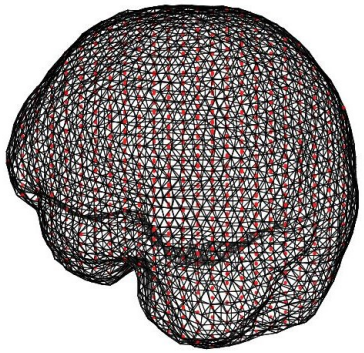
Beamformer power estimation

=



Beamformer details

For each source a spatial filter is constructed



Beamformer details

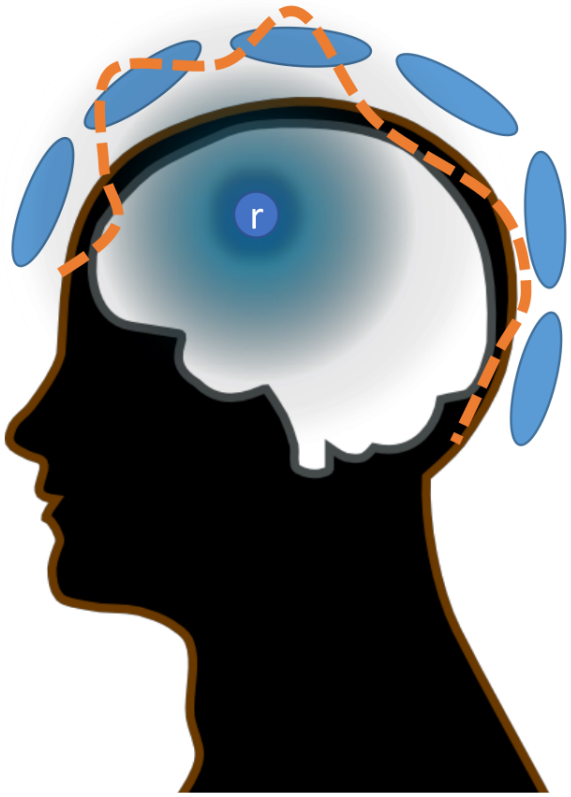
For each source a spatial filter is constructed

Beamformer details

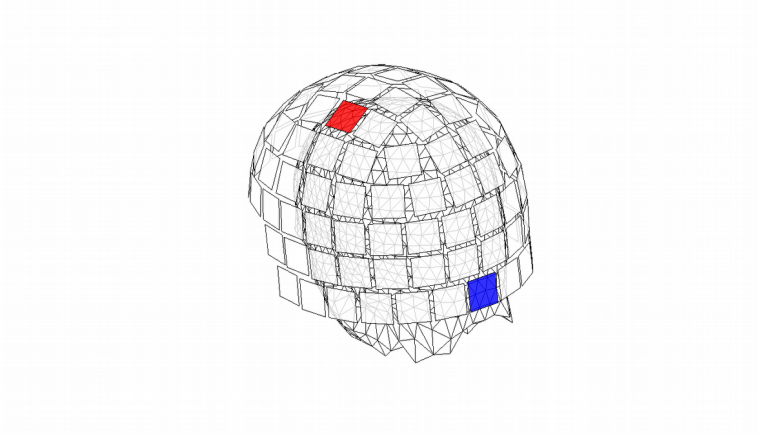
For each source a spatial filter is constructed

That filter maximizes input from sensors to which the source is most heavily linked and attenuates input from all other sensors. The filter weights the leadfield

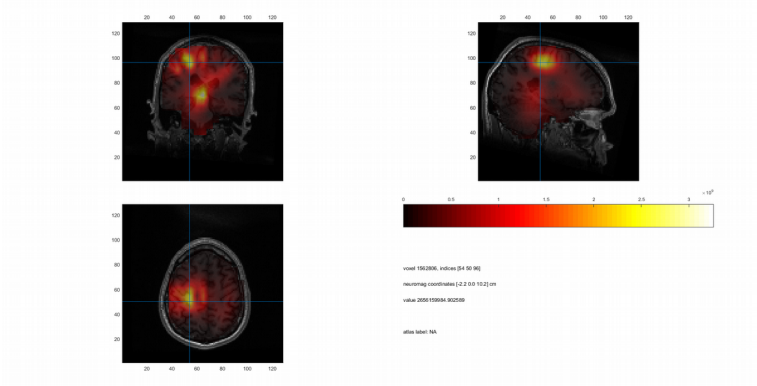
This is subject to the unit-gain constraint



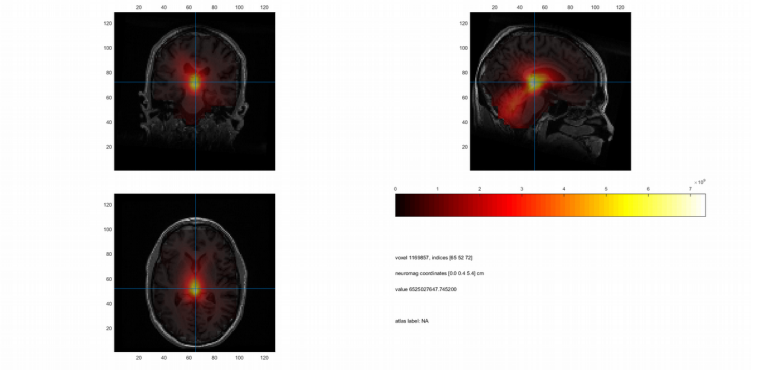
Examples of spatial filters



Red channel



Blue channel



Centre of the head bias is visible here (due to the unit gain constraint)