UNIVERSITÀ DEGLI STUDI DI PADOVA

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

COMPARING IMAGE RECONSTRUCTION OF DOT DATA FROM DIFFERENT ARRAY CONFIGURATIONS BASED ON DISTANCES

Group 8:

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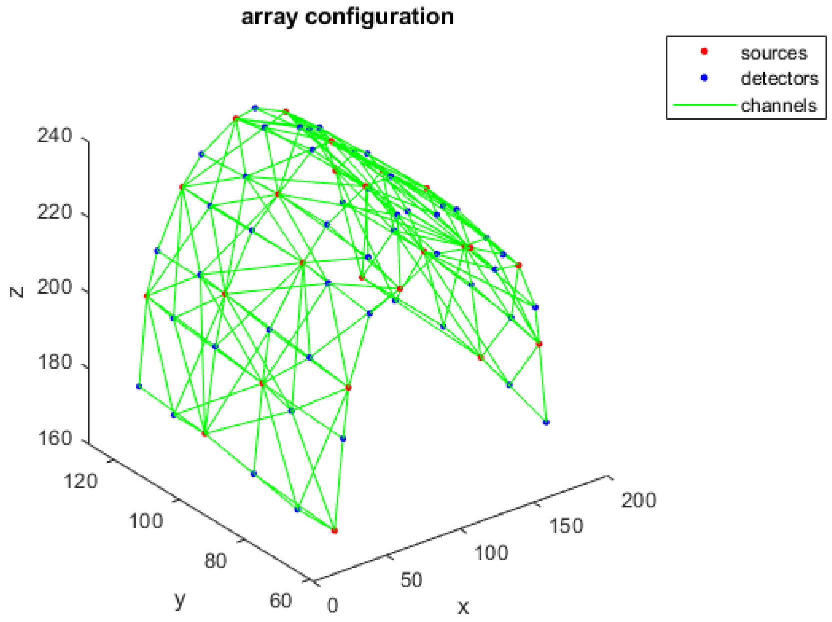
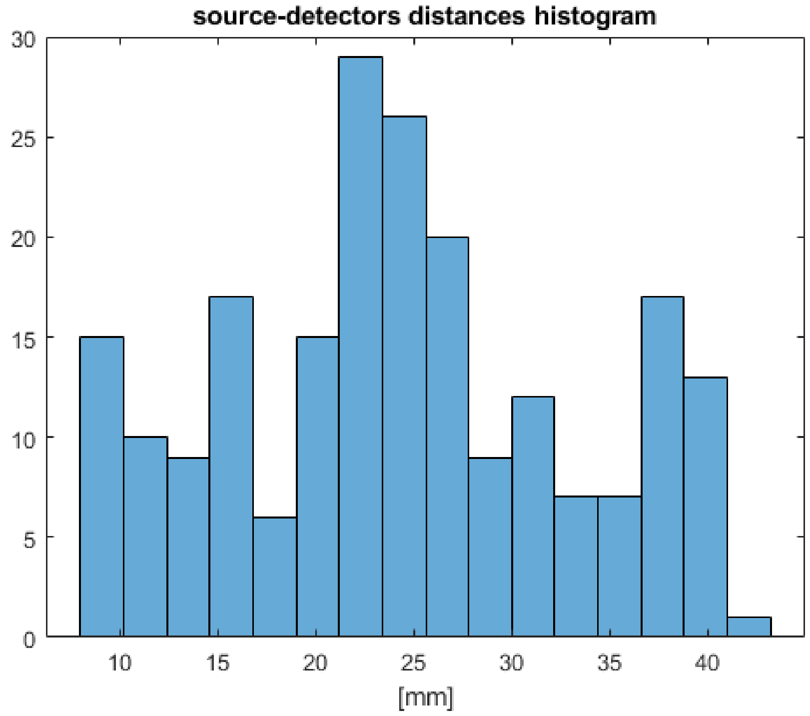
DATA VISUALIZATION

Here the plot of the 3D array configuration of sources, detectors and channels and the histogram of source-detector distance for each channel are shown. DOT data are acquired from one adult subject participating in an experiment evaluating the different activation pattern between texting on a mobile phone using the right hand and texting on a mobile phone using the left hand, while walking around.





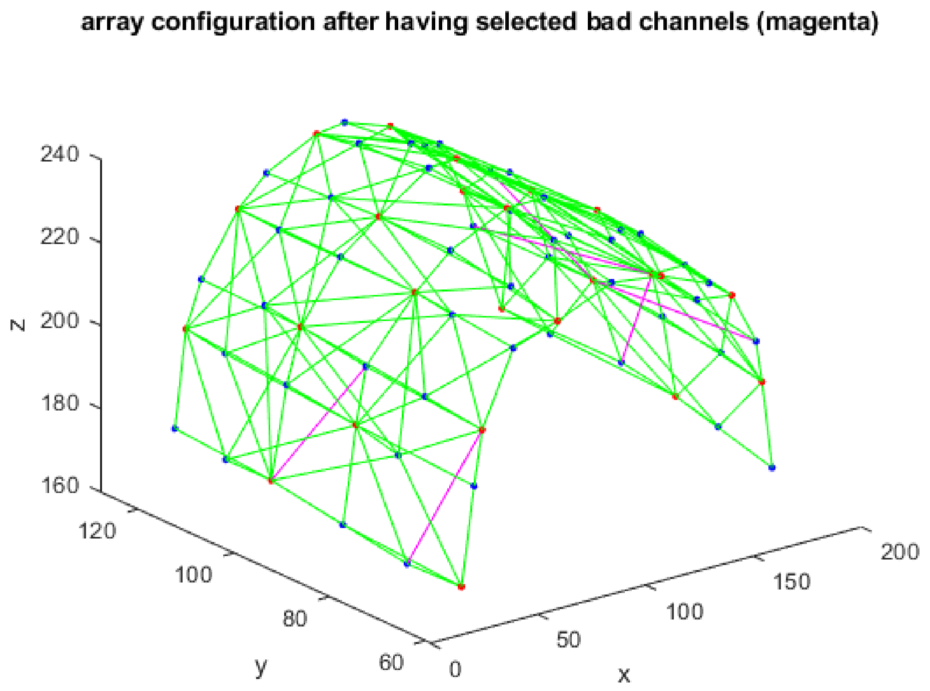
NOISY CHANNELS REMOVAL

“Bad” channels are those channels with average intensity lower than 500 or higher
than 1e10 or with signal-to-noise ratio (SNR) lower than 0.

The task was computed with the function “removeNoisyChannels” from lab 2.

The output remCh is a column vector with 0 for channels to be removed and 1 for channels to be kept. This vector was then placed in the SD.MeasListAct field.

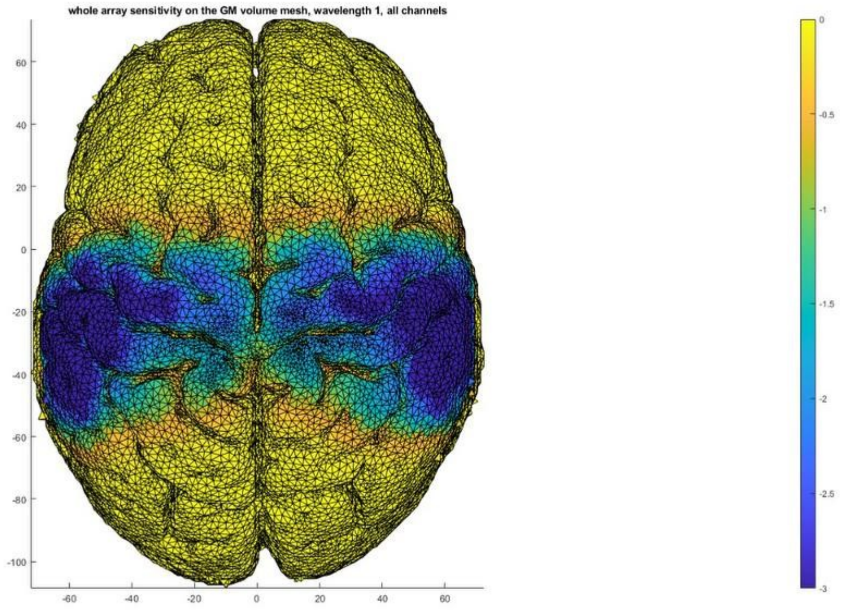
On the right it’s plot the array configuration highlighting bad channels in magenta.

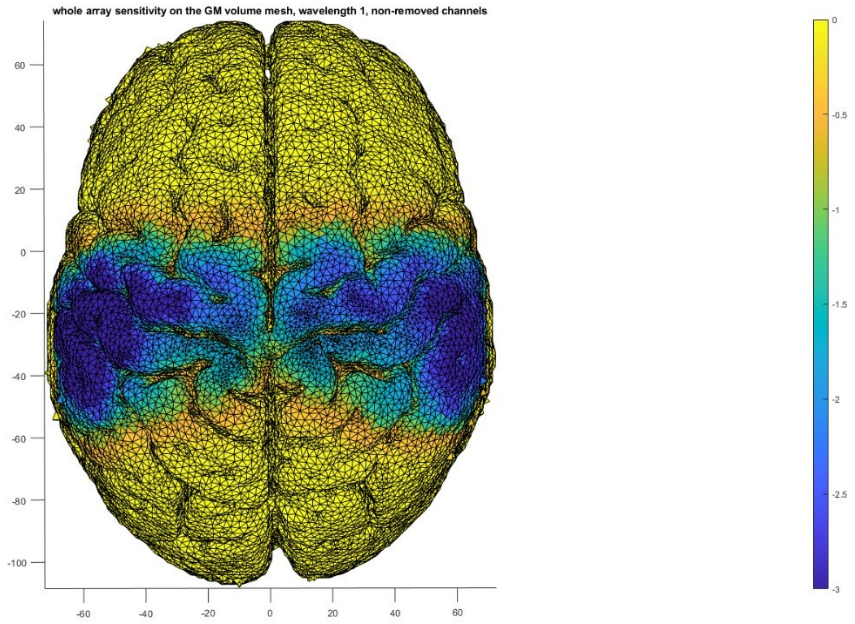


ARRAY SENSITIVITY ON THE VOLUMETRIC GM MESH

In this section the goal is to display the whole array sensitivity for the first wavelength on the volumetric GM mesh.

After loading the Jacobian matrix, the array sensitivity is plotted on the GM volume mesh for the original array (on the left) and for the one we got after removing the noisy channels (on the right). As we can see there is not any noticeable difference between the two.





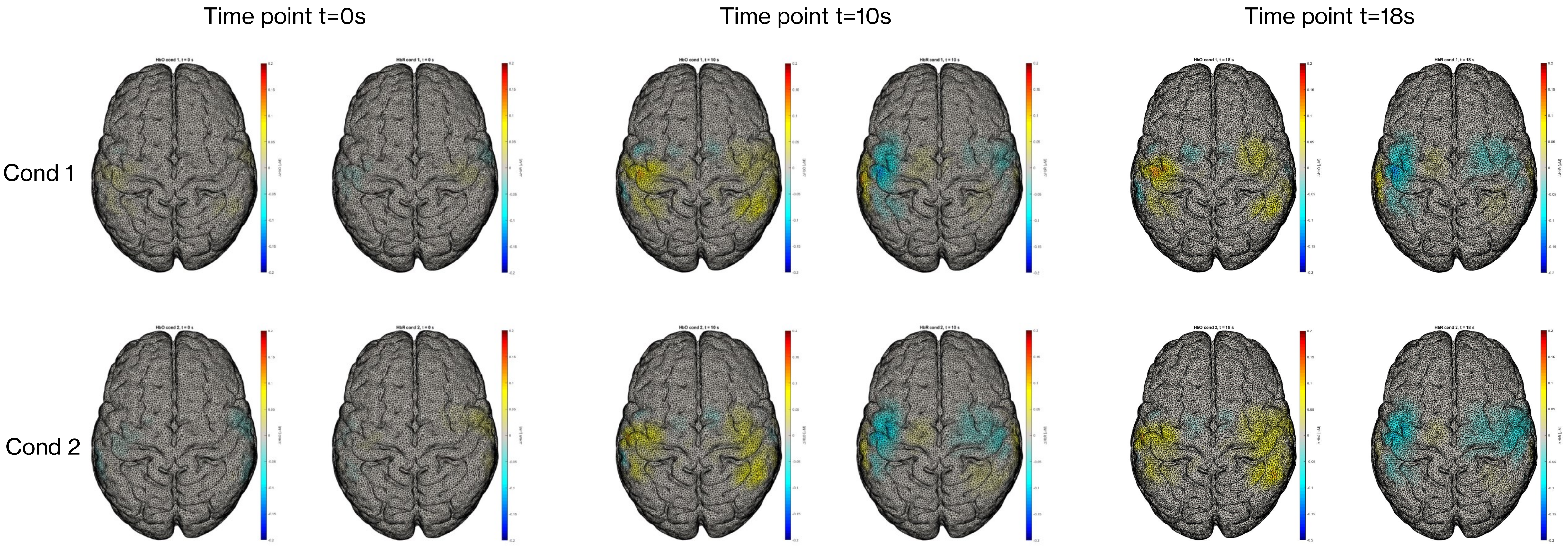
fNIRS DATA PRE-PROCESSING

The pre-processing of fNIRS data is performed:

1. Conversion to optical density changes.
2. Motion correction performed with the wavelet motion correction with iqr=0.5.
3. Band-pass filtering with cut-off frequency 0.01 and 0.5 Hz using the “hmrBandpassFilt” function.
4. Computation of the average optical density hemodynamic response for each channel and condition in a time range of -2 to 40 seconds from stimulus onset with the block average approach. The average is computed for the two trials for each condition and corrected for the baseline by removing the mean of the signal in the [-2 0] seconds interval range.

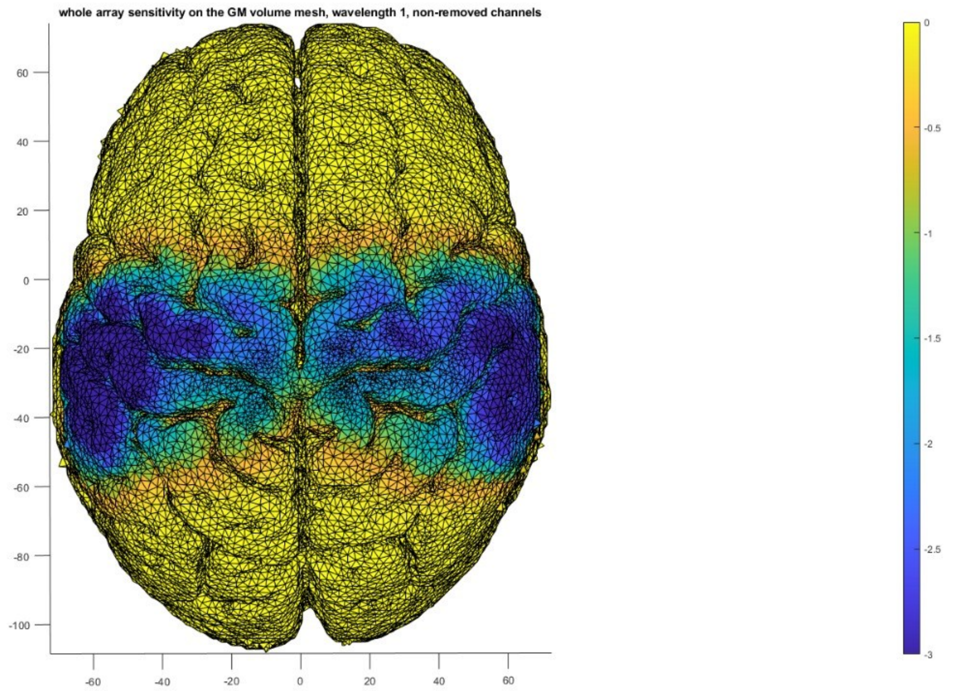
RECONSTRUCTION OF HbO AND HbR IMAGES

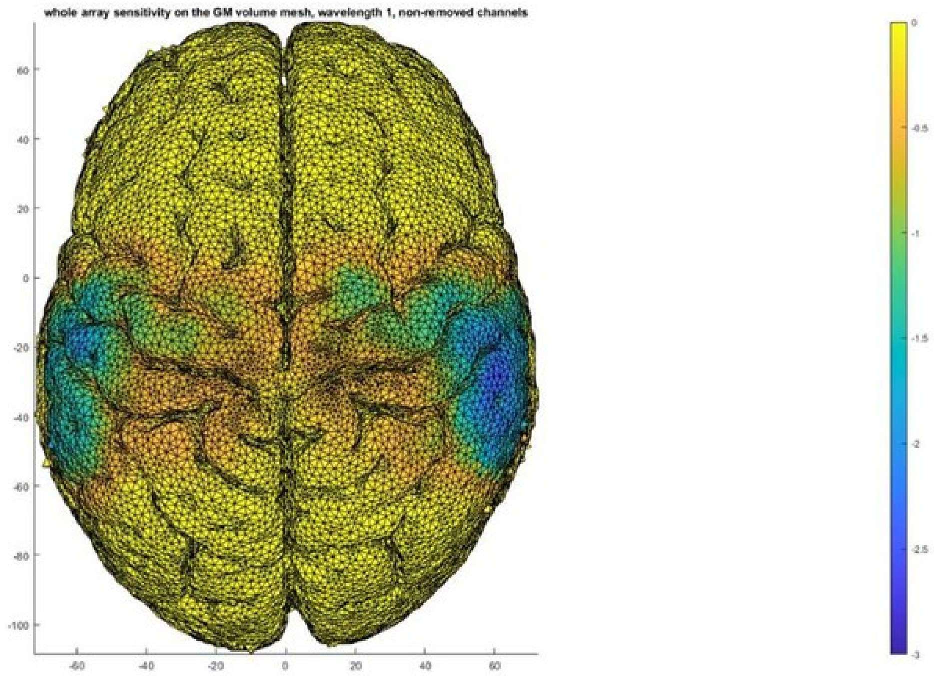
Reconstruction of HbO and HbR images for both condition 1 and 2, mapped to the surface GM mesh. We used lambda1 = 0.1 for the regularization.



FULL-ARRAY SENSITIVITY VS SHORT-CHANNEL-DISTANCE ARRAY SENSITIVITY

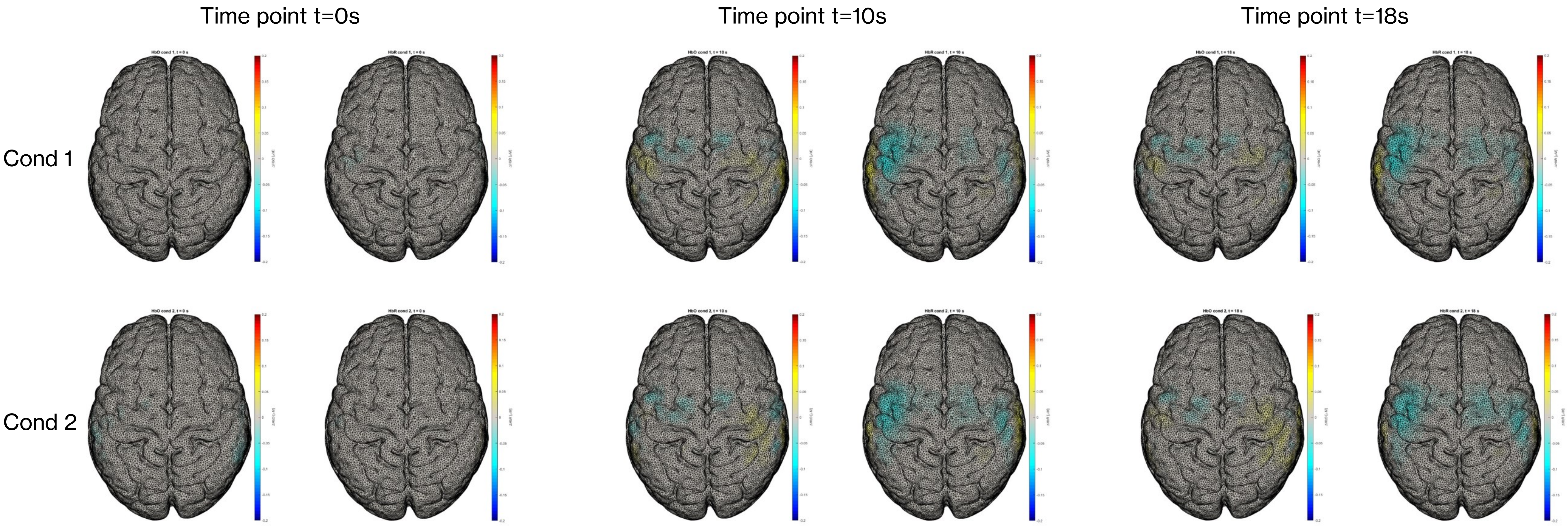
The following images represent the array sensitivity we got after removing the noisy channels in point 3 (on the left) and the array we got after removing all channels with distance>=30mm (on the right). As we can see, the sensitivity on the brain activity is much worse in the one in the right.





RECONSTRUCTION OF HbO AND HbR IMAGES FOR SHORT-DISTANCE CHANNEL ARRAY

Reconstruction of HbO and HbR images for both condition 1 and 2 mapped to the surface GM mesh, after removing from the array all channels with source-detector distance >= 30 mm.

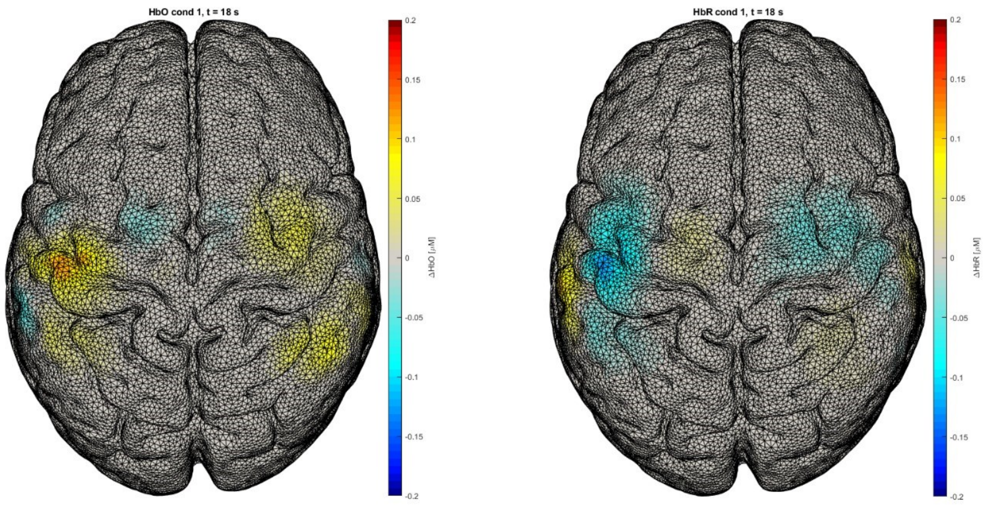


CONCLUSIONS

The reconstruction made without removing the channels with distance >=30mm is the more accurate one since, as we can also see from the array sensitivity, it has a much better resolution of the brain activity.

In addition, if HbO increases HbR is supposed to decrease and vice versa, but this doesn't happen in the case of the array in which we removed the long-distance channels.

Full array at time t=18s for condition 1



Full array at time t=18s for condition 2