Inverse solution using the subject MRI: The realistic head model.

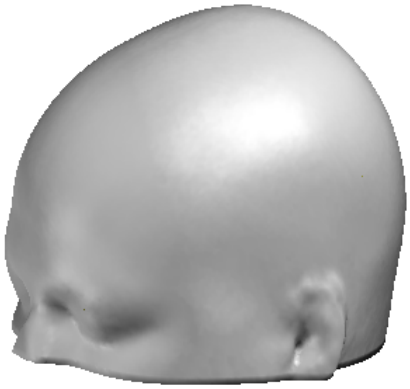
To calculate the inverse solution (LAURA, EPIFOCUS, ELECTRA) we need a head model that can be computed from the subject MRI. If there is no anatomical MRI available, you can use the average head model provided by the MNI. This head model corresponds to the average of 152 T1-weighted MRI images as used for example in SPM.

In the following we describe the steps needed to compute the head model from the MRI subject. For compatibility reasons we encourage the use of ANALIZE format to store the images and the Right Hand Oriented System for the computations.

1) Image segmentation and orientation

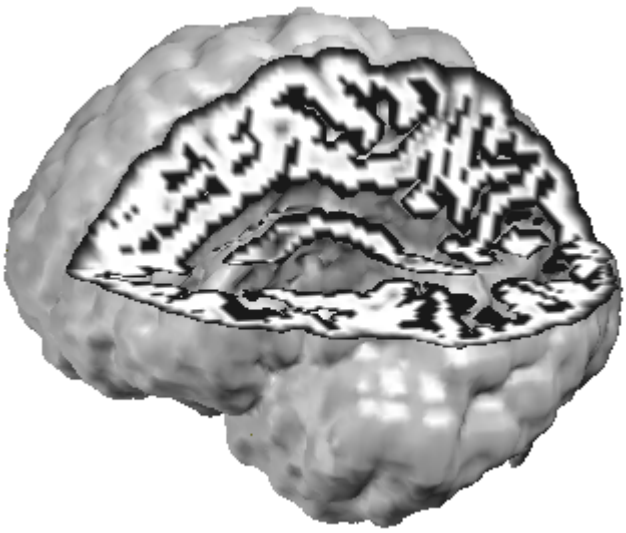
The MRI image is aligned with the Right hand oriented system and all the pixels of the MRI images are classified in one of the following classes:

a) External surface (e.g. for the average model).



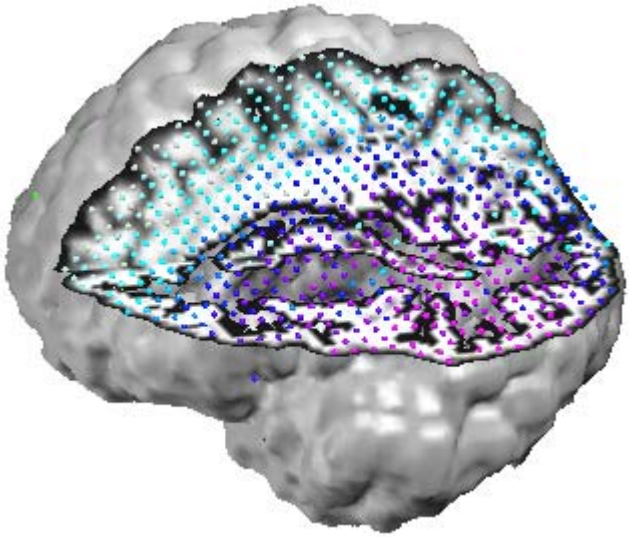
A correct detection of the external surface is needed for the landing of the electrodes and the construction of the realistic head model.

b) Brain surface as well as the white and the gray matter (e.g. for a subject).



2) Selection of solution points

From the 3D gray matter we select the points where we wan to compute the inverse solution.

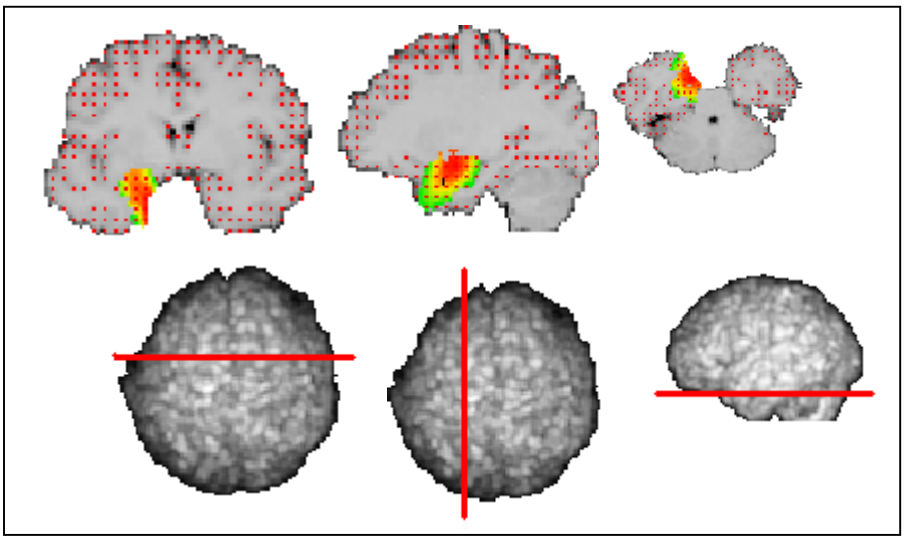


Solution points are selected on the gray matter covering the whole 3D brain space. Each solution point is classified according to the anatomical structure it belongs as well as the Taillarach coordinates to facilitate the analysis over subjects.

3) Computation of the lead field matrix

Compute the lead field matrix using the Boundary Element Method or approximate methods as SMAC guaranteeing the correct alignment of the midline of the electrodes configuration and the MRI head model.

Example of inverse solution computed and rendered on the original MRI



Localization of the epileptic focus of a temporal lobe epilepsy using EPIFOCUS and averaged spikes. Red dots indicate solution points. Red lines indicate the slice of maximum electrical activity.