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Bayesian Model Averaging in EEG/MEG imaging in Individual Brain Anatomy

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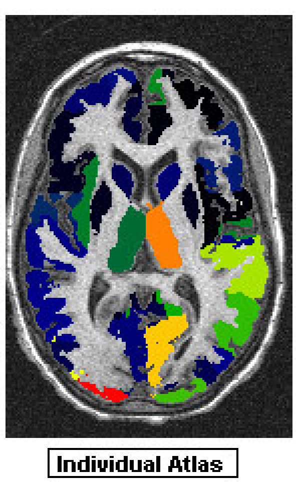
Recently, a new method Bayesian Model Averging in EEG/MEG imaging (BMA) has been developed (Trujillo et. al. 2003) based on a third inference level in the Bayesian formulation for the EEG and MEG inverse problem. The methodology used in that work considers different anatomical constraints taken from a segmentation into 69 compartments of the Average Brain Atlas of the Montreal Neurological Institute (MNI) (Evans et. al. 1994). The aim of this work is twofold: 1) to show the applicability of this new method using individual brain anatomy, 2) implementation of a methodology for obtaining Individual Atlases used for the source localization.
The process to obtain an Individual Atlas consisted of the automatic segmentation and classification of different structures (67 compartments) of each individual high resolution T1 weighted 3D MRI. The procedure followed here was: 1) Non-uniformity Correction of MRI 3D image, 2) Normalization: Spatial transformation to Standardized Space (Tailarach space), 3) Gray matter Segmentation and Identification of the Structures (from Average Atlas) in the standardized space, 4) Individual Atlas: Transformation of the segmented and classified MRI back to the individual space (see figure 1). An analog procedure has been described previously (Collins et. al. 1995, Collins et. al. 1998), for estimating automatically the volume of gross cerebral structures.
Once the Individual Atlases were constructed, the BMA method was applied to find the localization of sources involved in the processing of a specific visual stimulus. This stimulus consisted of a checkerboard (reversal frequency = 3 Hz; left and right hemifields separately, as well as full visual field stimulation) alternating with a fixation point, in a block design paradigm. The EEG and BOLD signals were recorded using the EEG-fMRI simultaneous recording technique (Goldman et al. 2000) in 5 subjects. The EEG recordings were properly artifact-filtered, windowed and averaged over trials. The source localization analysis via the BMA method was applied to the N1 component. In all cases well defined sources on the individual brain were obtained, matching with the fMRI activation pattern. The BMA solution for one of the subject analyzed is shown in Figure 2.



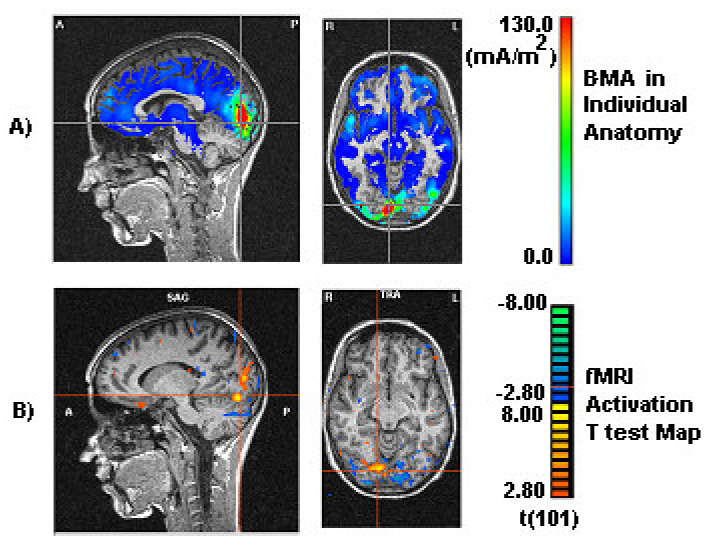


Figure 1: Individual Atlas of one subject. The segmented structures (compartments) in the individual anatomy are highlighted in different colors.

Figure 2: **A)** BMA solution for the N1 component of the evoked potential for Left Hemifield Stimulation. **B)** fMRI activation contrasting Left Hemifield Stimulation (in hot scale) versus Right Hemifield Stimulation (in winter scale).

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