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METHODS - ANALYSIS

Spatiotemporal Imaging of Brain Activation Using FreeSurfer

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INTRODUCTION

FreeSurfer is a software package that can be used to create high quality anatomical surface reconstructions and inflated or flattened representations of the cerebral cortex, as well as to visualize fMRI results on the cortical surface [1]. Here we introduce an extension to FreeSurfer that allows the analysis of magnetoencephalography (MEG) and electroencephalography (EEG) data, integrated with anatomical and functional MRI. The incorporation of MEG and EEG makes it possible to create movies of estimated spatiotemporal activity patterns in the brain.

METHODS

The cortical surface representations created with FreeSurfer [2,3] can be used to restrict the allowed locations of the MEG/EEG generators, with the option for constraining the source orientations to be perpendicular to the surface. Furthermore, the surface reconstructions of the brain, skull, and skin are used to generate a boundary element model for the conductivity geometry of the head [4]. The software also provides tools for co-registering the different imaging modalities and for interfacing with other popular packages for analysing imaging data. Source estimates for the MEG/EEG data are obtained by creating an inverse operator, in which noise covariance and prior information about the distribution of activity obtained from fMRI can be taken into account [5,6]. The estimated source distributions are visualized by overlaying them on the inflated representation of the cortical surface. The results are presented in the form of movies of the changing spatial activation patterns, or by displaying the solution time courses for interactively selected regions of interest.

RESULTS

FreeSurfer has been used for the analysis of several MEG/EEG studies. As an example, the figure shows time courses of estimated brain activity in selected regions during a verbal priming task. The data were averaged over 8 subjects and the locations of the regions of interest are indicated on an inflated average surface of the left hemisphere.

DISCUSSION

The extended FreeSurfer provides an integrated package for analysis and visualization of MEG/EEG data with anatomical and functional MRI for studies of dynamic patterns of activation in the brain. The created brain movies and solution time courses greatly help recognizing and understanding dynamic processes in specific locations as well as the interaction between these areas.

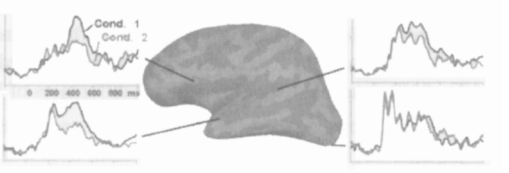

Figure 1.

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