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Minimum-Current Estimates with a Cortical Orientation Con

Fa-Hsuan Lin, John W. Belliveau, John W. Belliveau, Anders M. Dale, Matti S. I

MGH-MIT-HMS Athinoula A. Martinos Center for Biomedical Imaging

Modeling & Analysis

Abstract

Introduction

A widely employed distributed source localization approach in MEG and EEG is based on the L2 norm approach, resulting in minimum-norm estimates (MNE), ([1](#), [2](#)). However, more focal estimates can be obtained by using an L1 norm constrained implementation described in ([3](#)) requires information about the orientations of the sources, provided by MNE. Here, we provide information about local cortical anatomy taking into account the variation of the cortex orientation in the neighborhood of the source location. The results from an auditory MEG experiment demonstrate that MCE using anatomically informed source orientations produces more focal current source estimation compared to MNE.

Method

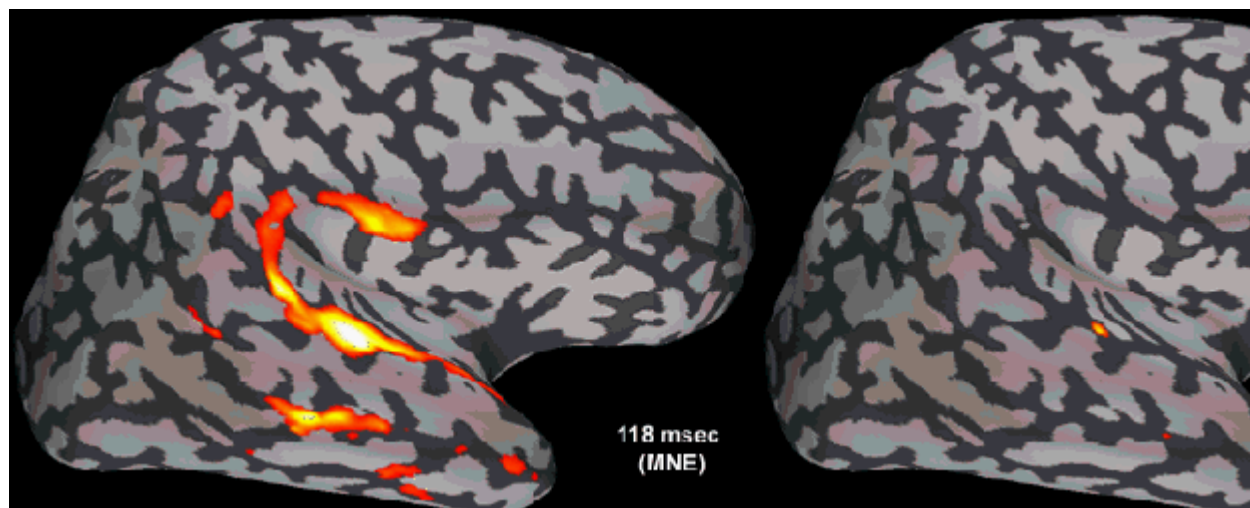
The geometry of the grey-white matter surface in the cortex was derived from high-resolution T1 MRI to yield a triangulation of 340,000 vertices ([4](#), [5](#)). The original triangulation was decimated to a source space of 3,889 dipoles with a 10-mm distance between nearest two dipoles. The Dijkstra algorithm ([6](#)) along the edges of the cortical mesh was employed to yield distances from each of the decimated source points to the original brain mesh. For each vertex of the original brain mesh, the closest decimated dipole location was determined. Subsequently, local cortical patches were created as sets of vertices sharing the same closest decimated dipole location.

With information about the vertices constituting a patch, the averaged cortical orientation associated with each patch and the standard deviation of orientations within the patch were estimated. This information was employed in the initial MNE source localization. Normal orientation is preferred and the amount of current allowed in the local tangential plane is determined by the standard deviation of orientations. Subsequent MCE estimation was implemented by regularizing the lead fields using singular-value decomposition with rank to 200. Linear programming ([7](#)) was then used to estimate the optimal dipole strengths given the orientation from the MNE.

The anatomically informed MCE was applied to an auditory MEG experiment in a healthy subject. The stimuli consisted of white noise (2K Hz central frequency with 4K Hz bandwidth, 70 msec duration). A 306-channel MEG system (Neuromag, Helsinki, Finland) was used to record the neuromagnetic responses.

Results

Figure 1 shows the MNE and MCE estimates from the auditory MEG experiment at 118 msec after the onset of the auditory stimulus. The dipole estimates were normalized between 0 and 1. The figure shows activated region in the temporal lobe using a 306 channel MEG system. The L2 norm produces more focal estimates.



Conclusion

In this study, we demonstrated the use of anatomical information derived from the high-resolution MRI in the calculation of minimum current estimates from MEG data. In particular, the initial MNE employs the distribution of the local cortical normals within each patch. The result from an auditory MEG experiment shows highly localized activation within the auditory cortex.

References

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