A Superior Software Solution for Functional MEG (Magnetoencephalography) Brain Imaging

Tech ID: 19798 / UC Case 2009-826-0

BACKGROUND

One of the most widely used techniques for functional brain imaging is magnetoencephalography (MEG), which works by measuring the magnetic fields generated by the electrical activity in the brain. It can measure the brain's neuronal activity with millisecond temporal resolution. Because the brain's magnetic field is considerably smaller than the magnetic noise within an urban environment, extremely sensitive measurement devices have been developed to measure MEG. In order to reduce the ambiguity that inevitably results from measuring such a signal weaker than the white noise of an urban environment, additional specific assumptions must be made about the nature of the neuronal sources (termed "source models"). Several problems are often associated with these source models, ranging from the lack of ability to produce high quality images to unrealistic assumptions. Minimum L1-norm solution source models, which provide high spatial resolution images, have been used by many investigators to analyze MEG responses. However, conventional minimum L1-norm approaches suffer from instability in spatial construction, and poor smoothness of the reconstructed temporal courses. One often sees activity "jumping" from one grid point to the neighboring grid points and the temporal-course of one specific grid point can show substantial "spiky-looking" discontinuities.

TECHNOLOGY DESCRIPTION

Dr. Huang at UC San Diego has developed a vector-based spatial–temporal analysis using a L1-minimum-norm (VESTAL) solution. This technology overcomes the problems associated with conventional minimum L1-norm approaches. The simulations showed that VESTAL could resolve sources that are 100 percent correlated; therefore, additional assumptions about their temporal dynamics are not needed, eliminating potential skewing of images. Furthermore, when VESTAL was used to analyze human median-nerve MEG responses, it demonstrated high temporal stability and spatial resolution due to its capability of distinguishing sources that were exceedingly close in proximity to each other.

ADVANTAGES

- High spatial stability and continuous temporal dynamics, without compromising spatial or temporal resolution.
- Elimination of "spiky-looking" discontinuities that are often observed in the conventional minimum L1-norm approaches.
- Reduced computational cost compared with many non-linear optimization approaches, such as non-linear multiple-dipole modeling.

APPLICATIONS

- Non-invasive detection of the exact site of brain abnormalities and localization of the sources of seizures in patients with epilepsy.
- Assists surgeons to localize and avoid the speech centers of the patient's brain during surgery.
- Establishes the functionality of various areas of the brain.

STATE OF DEVELOPMENT

VESTAL was tested in computer simulations and the performance of VESTAL was further examined using human MEG responses evoked by unilateral median-nerve stimulations. This is the first demonstration using MEG to map out the cortical areas in the somatosensory system simultaneously with high spatial resolution. In addition, VESTAL showed early activation in the thalamus and has the potential for localizing deep sources.

RELATED MATERIALS

- Huang MX, Dale AM, Song T, Halgren E, Harrington DL, Podgorny I, Canive JM, Lewis S, Lee RR. Vector-based spatial-temporal minimum L1-norm solution for MEG. Neuroimage. 2006 Jul 1; 31(3):1025-37.

CONTACT

University of California, San Diego
Office of Innovation and Commercialization
innovation@ucsd.edu
tel: 858.534.5815.

OTHER INFORMATION

KEYWORDS

lead field, MEG, minimum norm, spatial–temporal, median-nerve, L1-norm, dipole, functional brain imaging, VESTAL

CATEGORIZED AS

- **Medical**
  - Diagnostics

RELATED CASES

2009-826-0

University of California, San Diego
Office of Innovation and Commercialization
9500 Gilman Drive, MC 0910, ,
La Jolla,CA 92093-0910

Tel: 858.534.5815
innovation@ucsd.edu
https://innovation.ucsd.edu
Fax: 858.534.7345