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P015. Sensitivity of EEG and MEG to Orientation Selective Source Strength Variations

A. Hunold[1], M. Funke[2], R. Eichardt[1], J. Haueisen[1]
[1]Institute of Biomedical Engineering and Informatics, Ilmenau University of Technology, Ilmenau, Germany
[2]Department of Pediatrics, University of Texas Health Science Center at Houston, Houston, TX, USA

Clinical applications of simultaneous electroencephalography (EEG) and magnetoencephalography (MEG) recordings of interictal epileptic spikes revealed situations where both modalities showed different sensitivities to the epileptic-form activity. In previous studies, we showed that for focal and extended sources EEG and MEG provided varying sensitivities depending on the depth and the orientation of the spike source.

Here, we extend this work to effects of background source strength variations depending on the source orientation on the spike detectability in EEG and MEG simulations.

We build realistic 3-compartment boundary element method head models for 2 participants with 5120 triangles per layer.

The vertices in a triangular grid of the segmented boundary between white and gray matter provided the base points for single dipole sources. For each dipole, the angle between the source vector and the surface normal in the closest point of the inner skull mesh defined the source orientation. The Euclidean distance to the closest scalp vertex defined the source depth. In the baseline simulations, single dipoles generated interictal activity with a maximal strength of 600 nA m and approximately 30 000 randomly distributed dipole contributed to normal brain activity as background noise with an individual strength of 10 nA m. In further simulations, we selectively increased the strength of radial and tangential background sources to 300% of baseline strength. As detectability measure we calculated a linear ratio between spike and background amplitudes as signal-to-noise ratio (SNR) in the EEG/MEG channel with the maximal spike amplitude.

In the baseline simulations, spikes from radially oriented single dipole sources generated the highest SNR in EEG and tangential sources dominated the SNR in MEG responses for superficial source locations. With 3 times stronger radial background activity, the SNR in EEG responses marginally decreased and the SNR profiles of MEG simulations remained almost stable. Opposing, the increase of tangential background activity strongly lowered the SNR in MEG responses and also affected the SNR in EEG simulations.

Our simulations show complementary sensitivity profiles of EEG and MEG to superficial sources depending on their orientation. Due to the MEG's orientation selectivity, only increased tangential background activity lowered the SNR in MEG simulations.

The complementary SNR profiles of EEG and MEG to superficial sources indicate the benefit of simultaneous recording of both modalities.