The localization of epileptic sources (electric current dipoles) within the human brain is one of the major applications in inverse methods in electroencephalography (EEG). Independent component analysis (ICA) can be used to separate temporal and spatial EEG data into statistically independent components. From those components, we select just those that correspond to epileptic signals. We performed ICA on the EEG data from scalp surface electrodes and implanted cortical electrodes for an epilepsy patient; for each source component, we solved an inverse problem to locate the single dipole that best reproduced that component. For these patient-specific simulations, we built a heterogeneous, isotropic finite-element volume conductor model based on MRI data from the patient.

Open skull FE head model (4 segments of skin, skull, CSF, brain) with 430,939 nodes and 410,175 hexagonal elements. Depth electrodes (yellow) and surface electrodes (green).

IC3 independent component map on depth electrode grids (left top) and on head surface (left bottom) visualized with BioPSE. NeuroFEM inverse dipole fits for iEEG (blue) from depth electrodes and for sEEG (green) from surface electrodes.

NeuroFEM dipole (yellow) for IC3 independent component of iEEG (78 channels) and sEEG (29 channels) with scaling of 15.

IC1 independent component map on depth electrode grids (left top) and head surface (left bottom). NeuroFEM inverse dipole fit for iEEG (blue) from depth electrodes and for sEEG (green) from surface electrodes.

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