Electrical source imaging and connectivity analysis can help to localize the seizure-onset zone from ictal HD scalp EEG


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It would be of high clinical value to be able to localize the SOZ based on non-invasive ictal EEG recordings

Of the 70 million epileptic patients worldwide, ± 30% cannot be helped with medication. They are referred to the presurgical evaluation: can they benefit from epilepsy surgery?

Up to now, neurologists inspect the EEG visually to localize the seizure-onset zone (SOZ)

- subjective
- labor intensive
- real onset or spread?
- sometimes invasive EEG needed: medical risks

We propose an approach based on EEG source imaging followed by connectivity analysis

Ictal high-density (HD) EEG

• 5 patients, each 1 seizure
• 204 electrodes & subsets
• seizure free after surgery
• from seizure beginning
• duration 2.5 – 10 s

EEG source imaging (ESI)

ESI in Cartool (Brunet et al., 2011)

1 time series per selected source

Source selection

Connectivity Analysis

SOZ localization

Region with highest number of outgoing connections = SOZ

When using 204 electrodes, ESI + connectivity can successfully localize the SOZ in the resected zone (RZ) in 4 out of 5 patients. The reconstructed source with the highest power (in 3-40 Hz band) coincides with the RZ only in 1 out of 5 patients.

Performance decreases when less electrodes are used.

ESI + connectivity analysis outperforms SOZ localization based on power in most patients, however performance decreases when less electrodes are used.