

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

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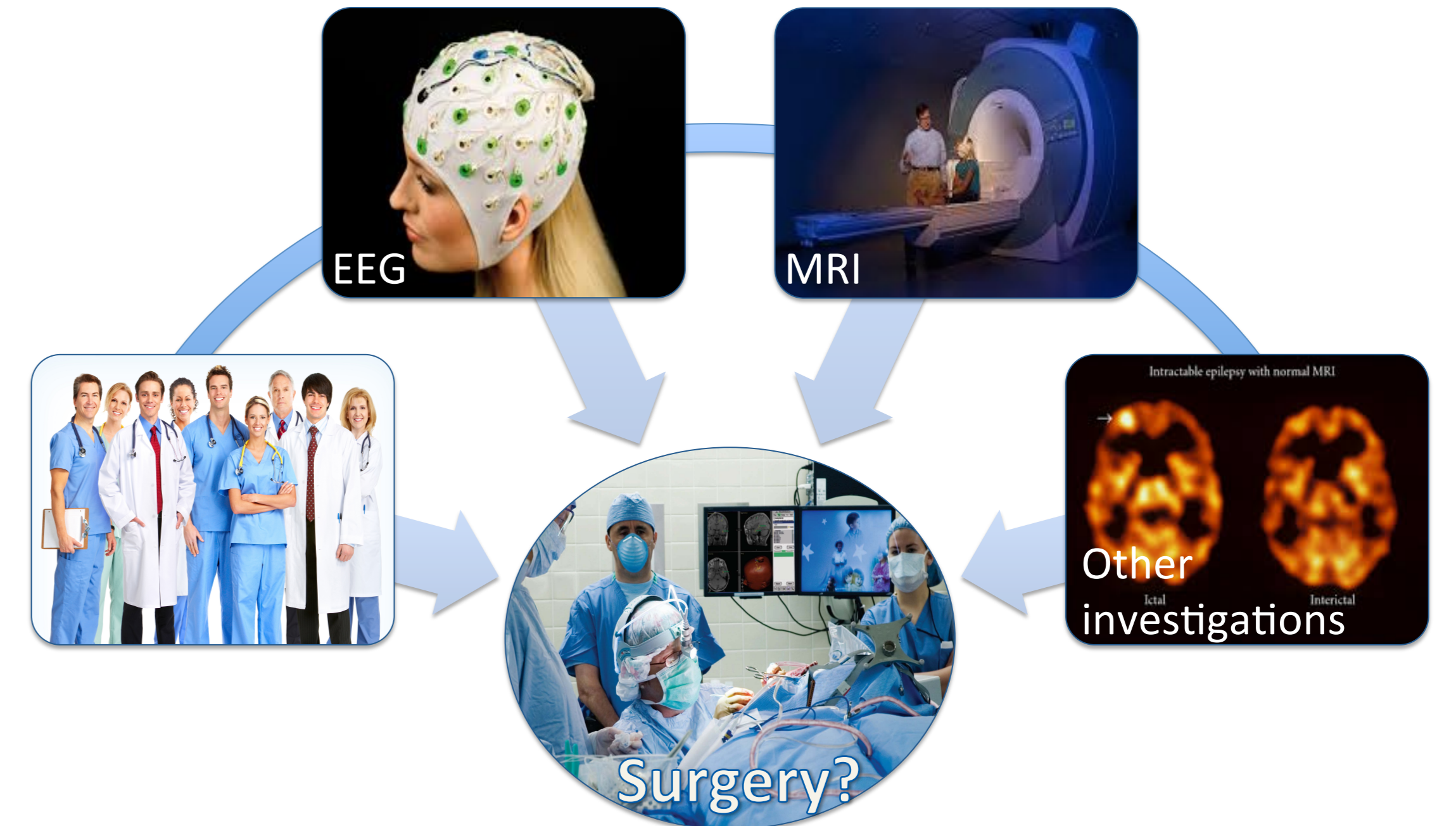
<http://medisip.elis.ugent.be>

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?

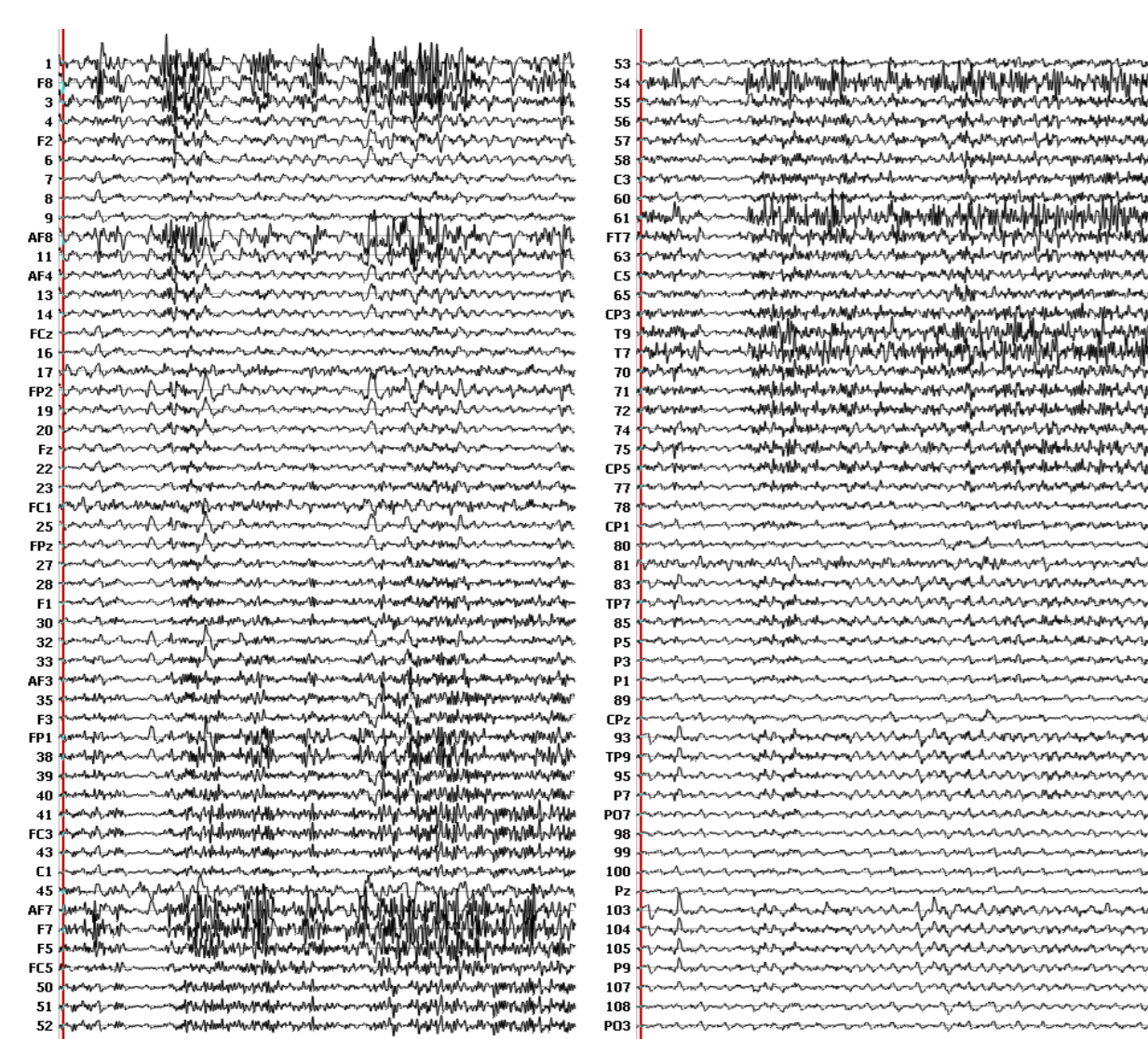
Up to now, neurologists inspect the EEG visually to localize the seizure-onset zone (SOZ)

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



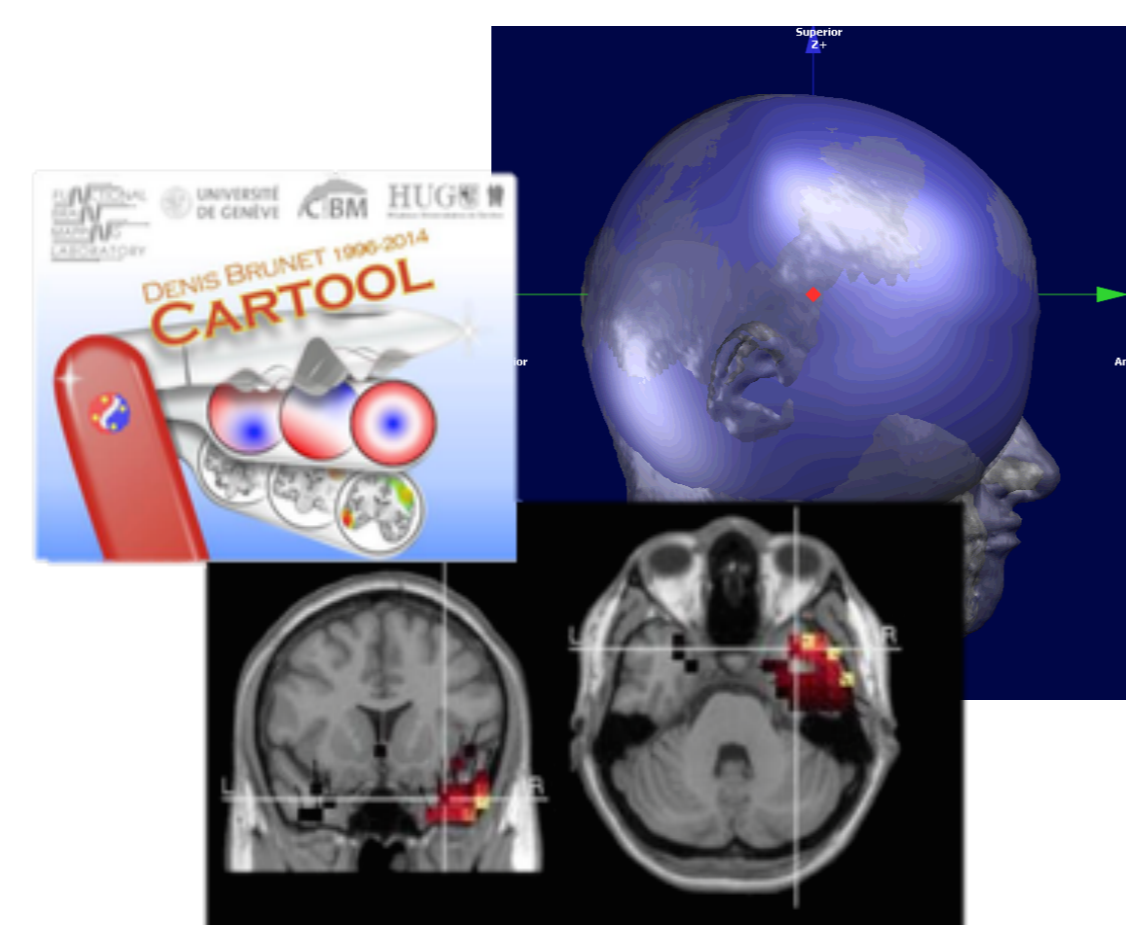
We propose an approach based on EEG source imaging followed by connectivity analysis

Ictal high-density (HD) EEG



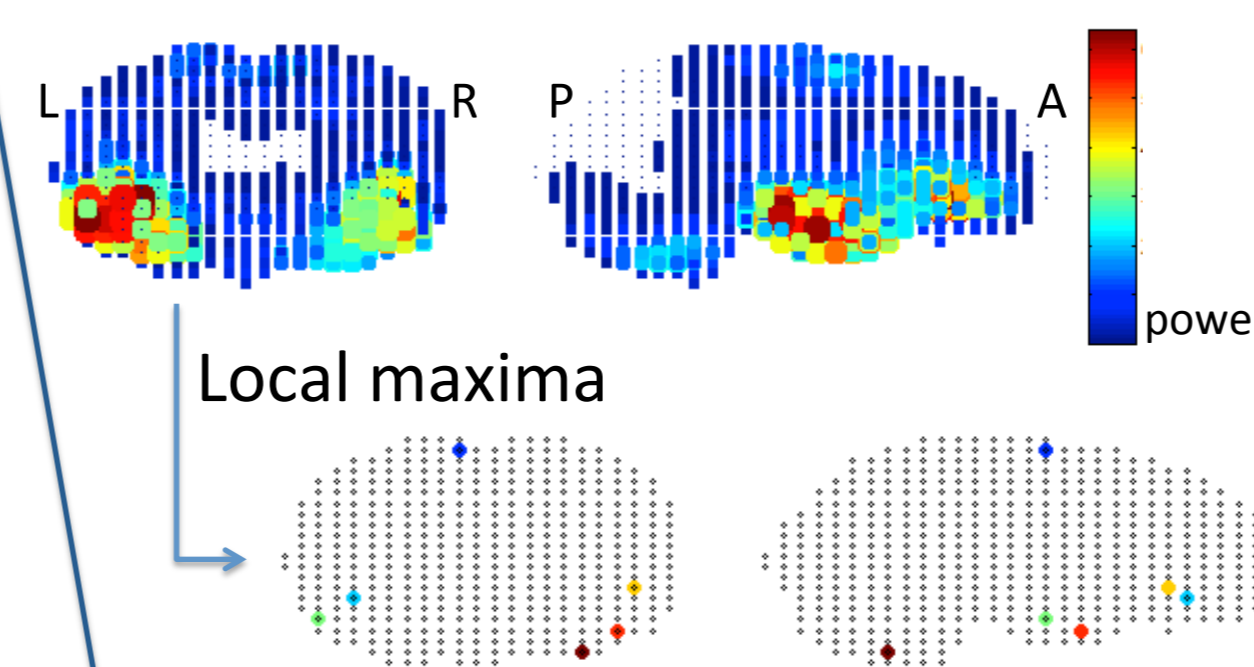
- 5 patients, each 1 seizure
- 204 electrodes & subsets
- seizure free after surgery
- from seizure beginning
- duration 2.5 – 10 s

EEG source imaging (ESI)

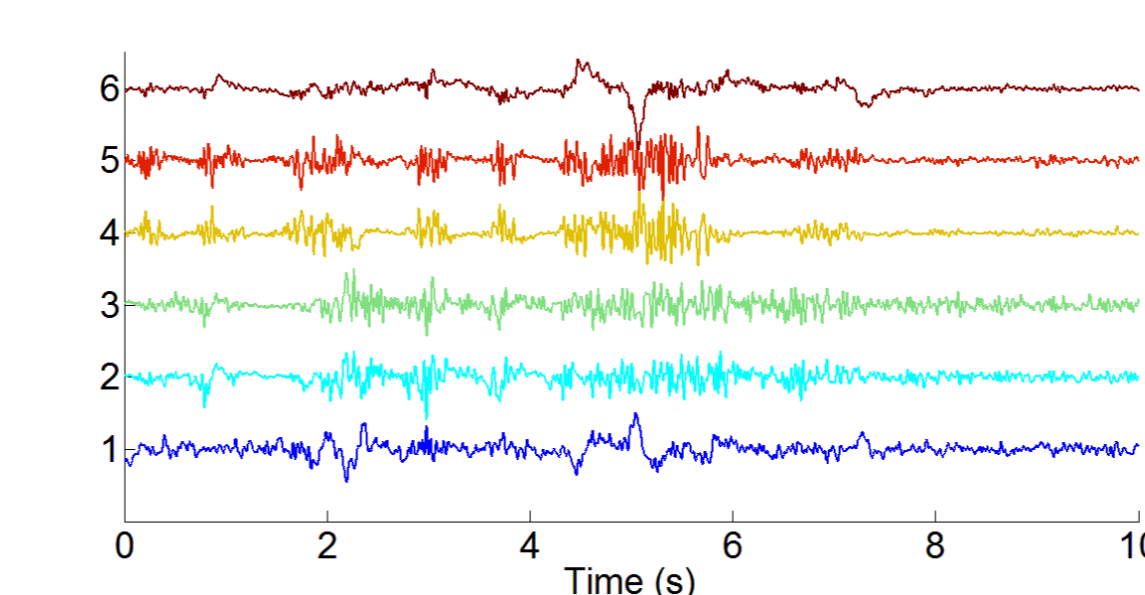


ESI in Cartool (Brunet et al., 2011)  
forward model: indiv. head model (LSMAC)  
inverse solution: LORETA

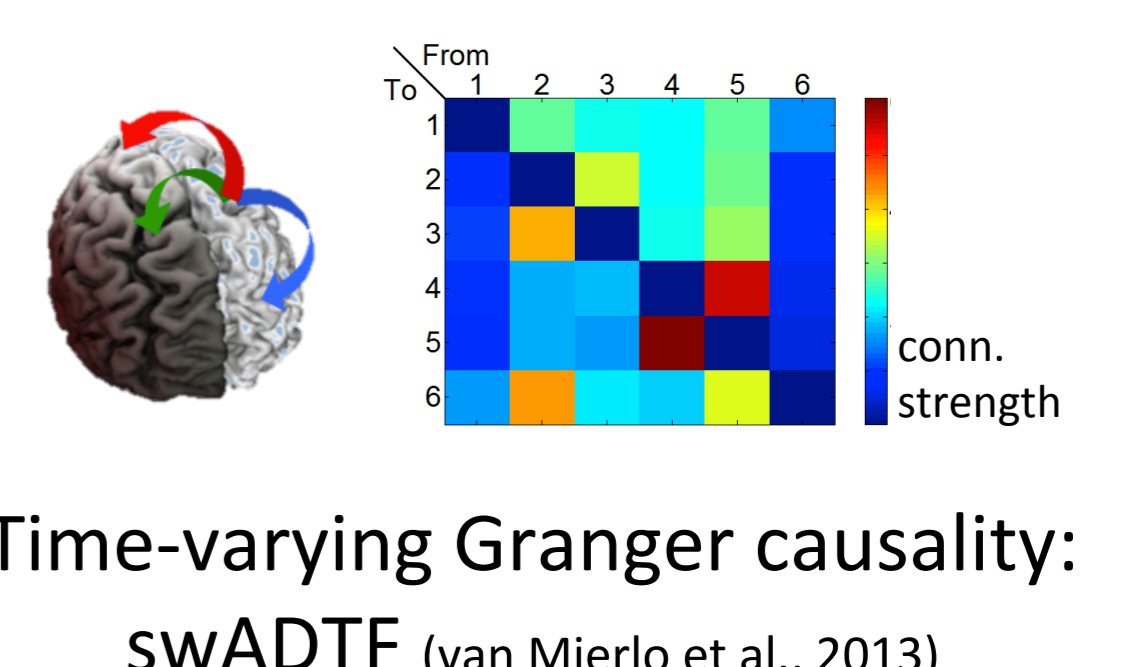
Source selection



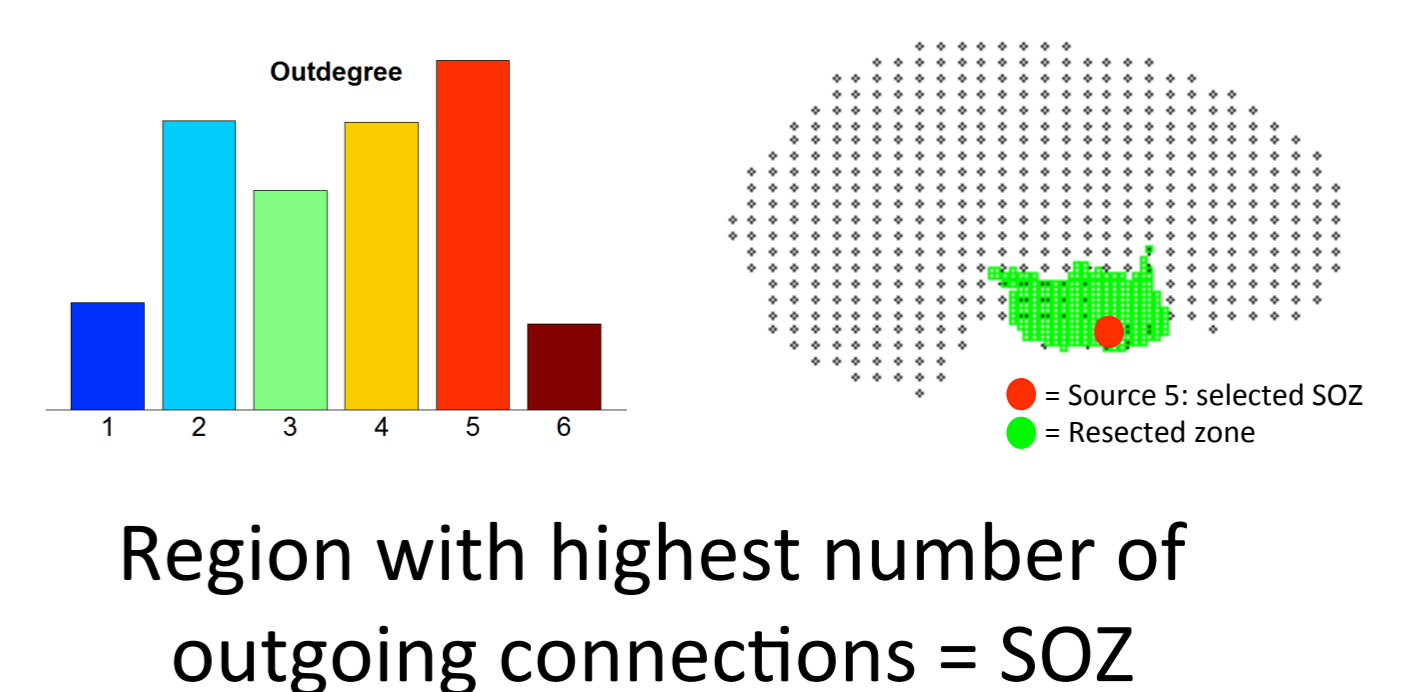
1 time series per selected source



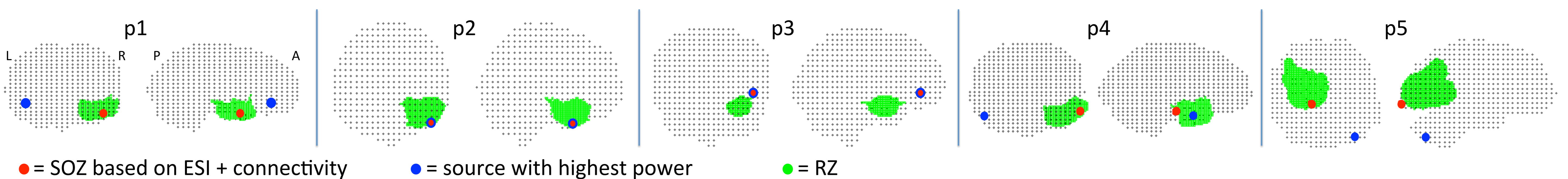
Connectivity Analysis



SOZ localization



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.

Distance to RZ (mm)	# electrodes	p1		p2		p3		p4		p5		mean	
		ESI + conn.	power	ESI + conn.	power	ESI + conn.	power	ESI + conn.	power	ESI + conn.	power	ESI + conn.	power
	204	0	69.0	0	0	23.2	23.2	0	67.1	0	52.8	4.6	42.4
	196	0	69.0	0	0	23.2	23.2	0	67.1	0	40.0	4.6	39.8
	188	0	40.5	0	0	23.2	23.2	96.0	67.1	0	40.0	23.8	34.1
	180	0	69.0	0	0	23.2	23.2	95.3	67.1	0	40.0	23.7	39.8
	172	0	17.4	0	0	23.2	23.2	95.3	67.1	75.5	40.0	38.8	29.5
	164	17.4	17.4	64.8	0	81.4	81.4	66.0	77.8	0	40.0	45.9	43.3

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