

Introduction :

A method using spatial ICA has been developed for detecting functional large-scale networks specifically in EEG [1]. After an individual step, a clustering of the independent component from the different subjects formed spatially coherent and representative classes. This results are compared with fMRI studies [2] using a stepwise regression.

MATERIEL & METHODS

Individual analysis

Hypothesis :

- power EEG time series convoluted with an hemodynamic response correlates with fMRI BOLD signal [3].
- Spatial ICA extracts functional networks in fMRI data [2].

Goal : Can we apply sICA in EEG to detect functional networks ?

Method :

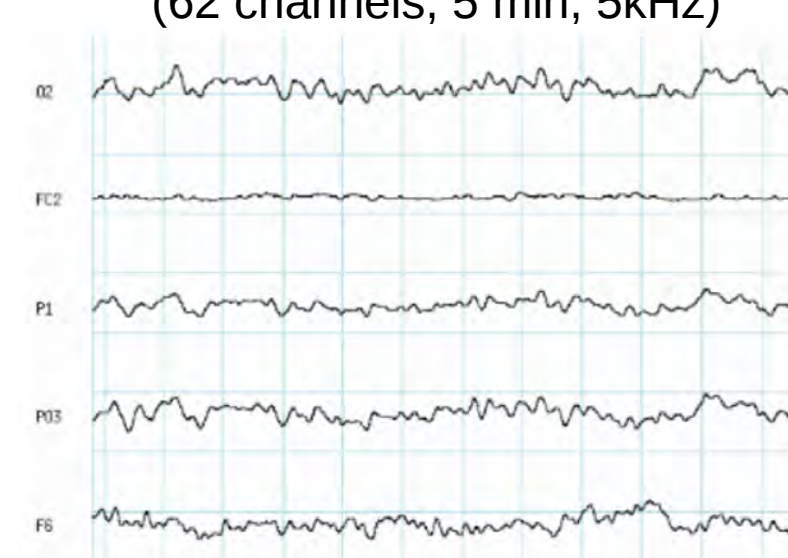
- **Preprocessing** (artefact removals)
- **Source localization** (minimum-norm)
- 2 seconds **time-windows**
- Concatenation of **EEG-power** in different frequency bands
- **Spatial ICA** (mutual information - 200 components)

Frequency Bands				
Delta	Alpha	Beta	Gamma1	Gamma2
1-7 Hz	7-13 Hz	17-23 Hz	27-33 Hz	34-40 Hz

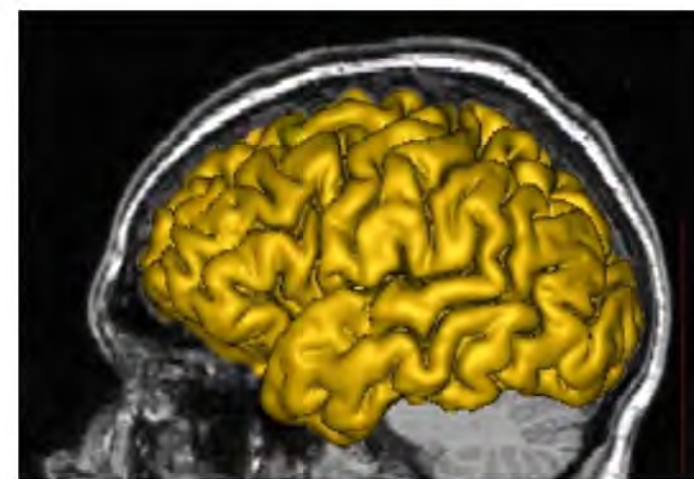
Data :

- 12 healthy subjects
- Resting states (5 min)
- 62 channels at 5 kHz + EOG + ECG
- IRM T1 for anatomy

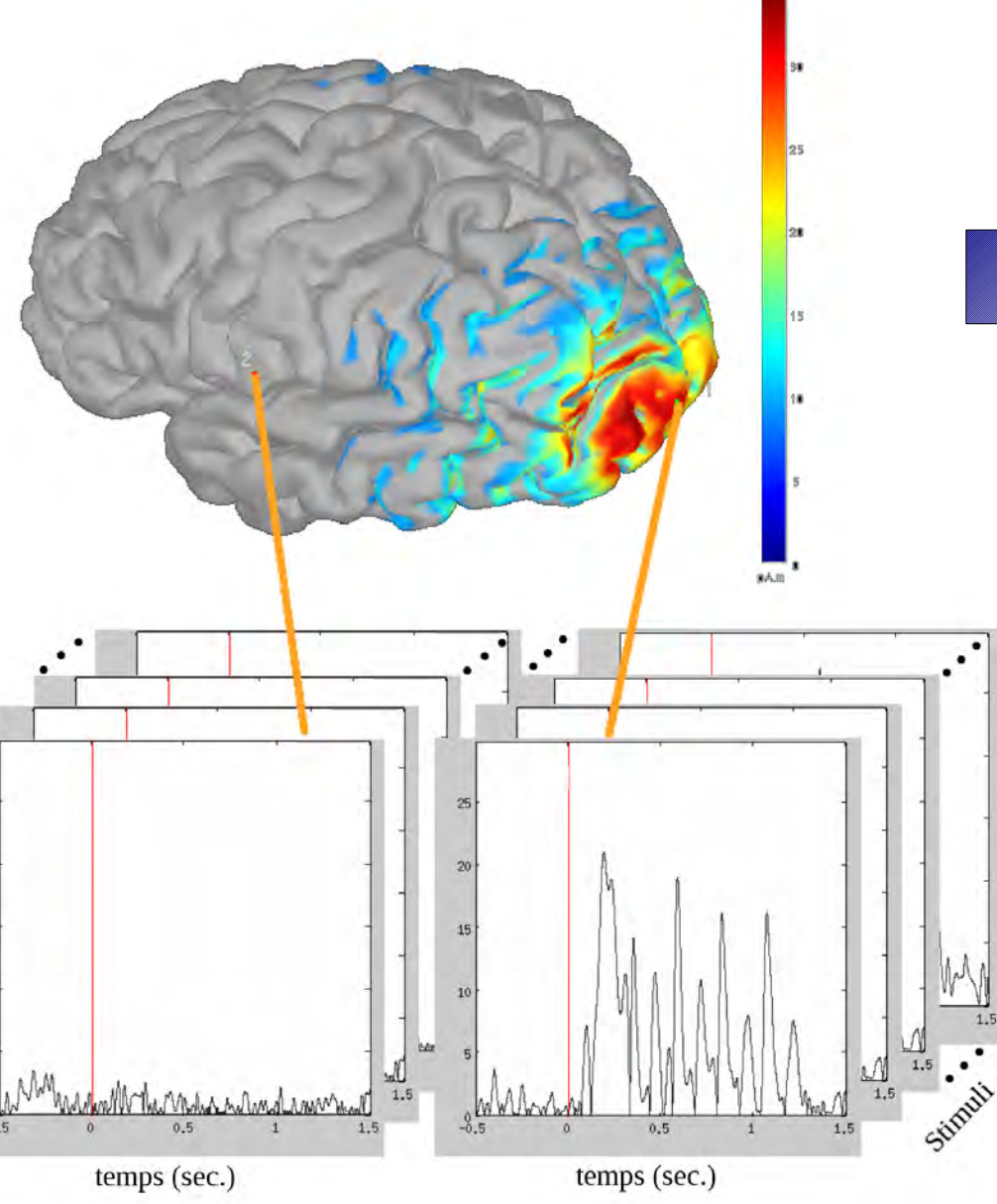
Preprocessed Resting state's EEG data
(62 channels, 5 min, 5kHz)



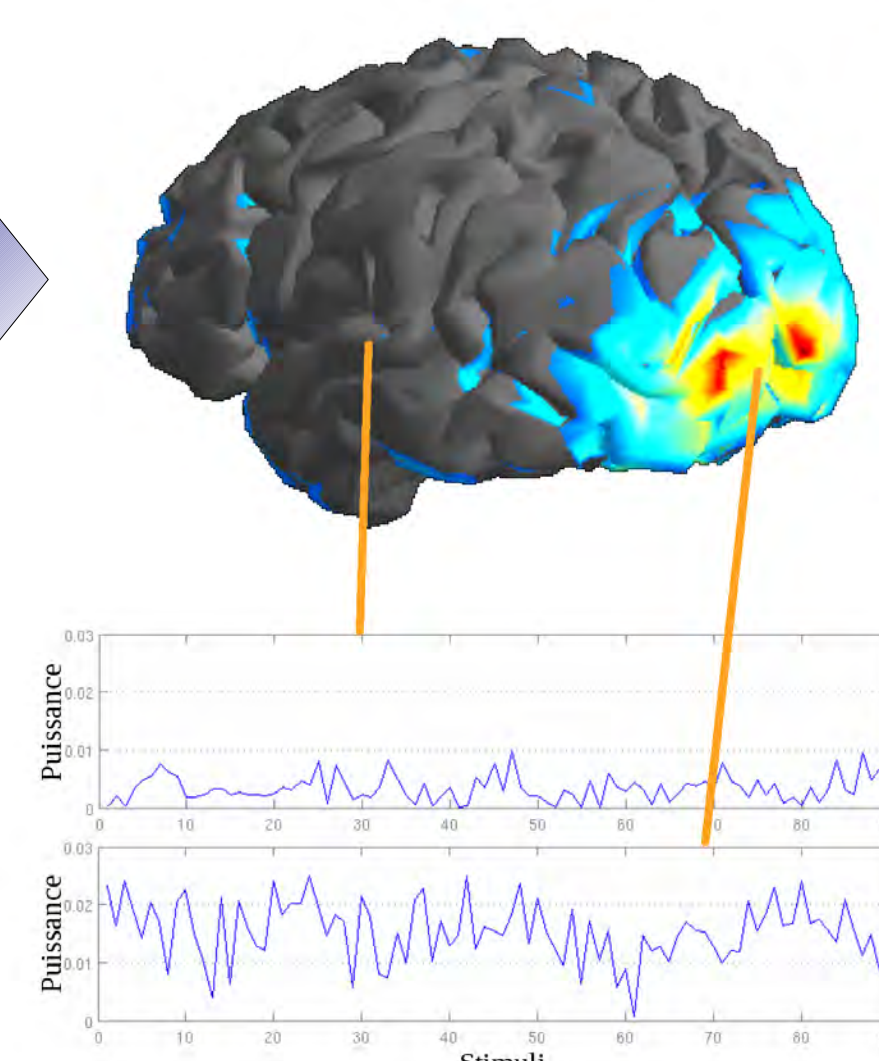
Anatomical information (T1 MRI)
Segmentation with Brainvisa



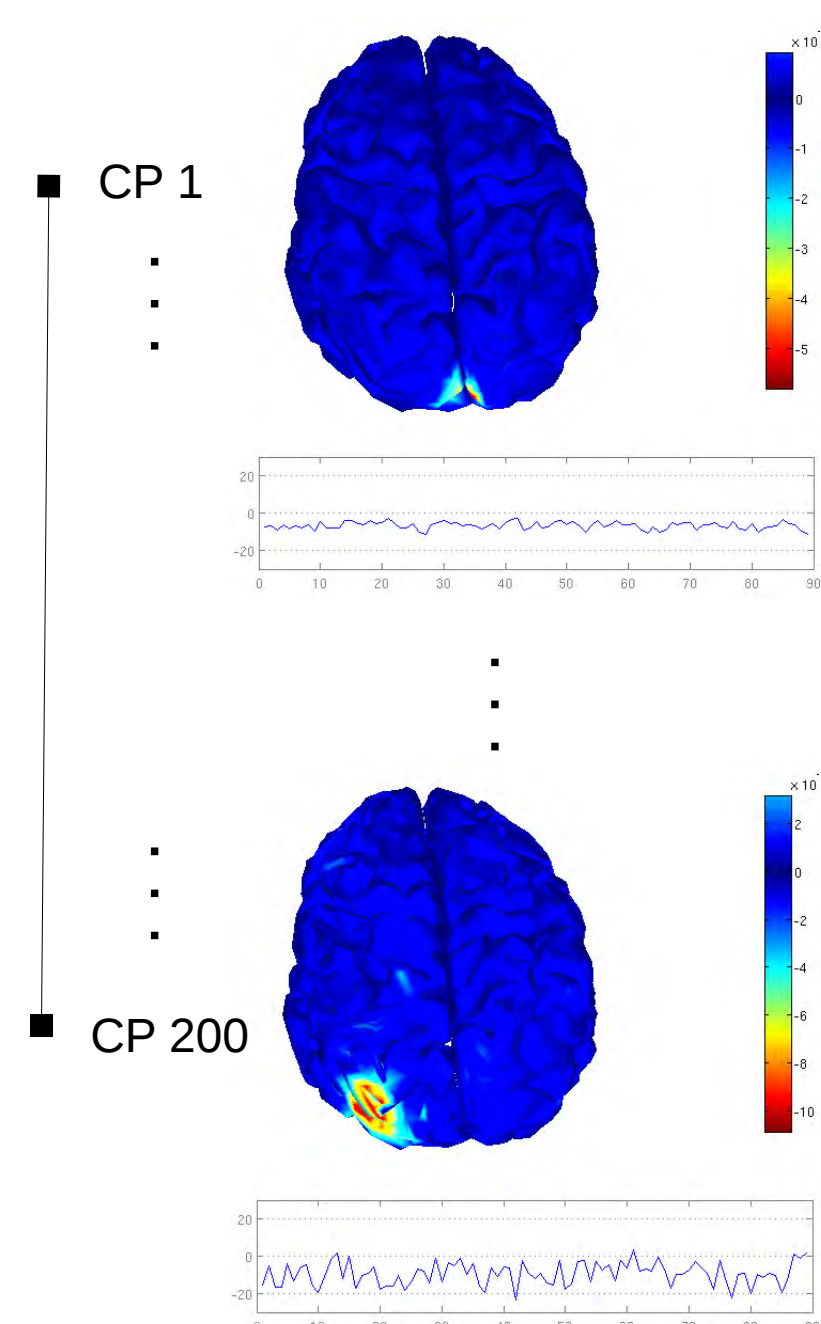
Source localization



Power EEG time series



Sources separation with spatial ICA



Group analysis

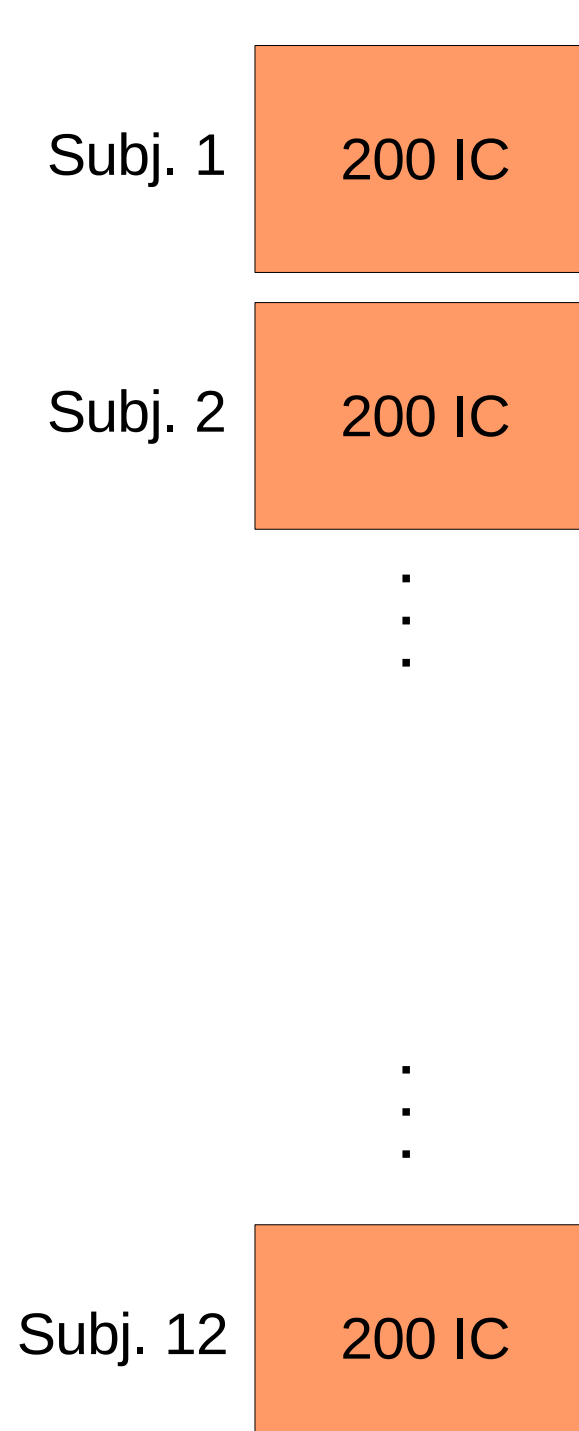
Hypothesis :

- Functional networks are reproducible across the population [2]

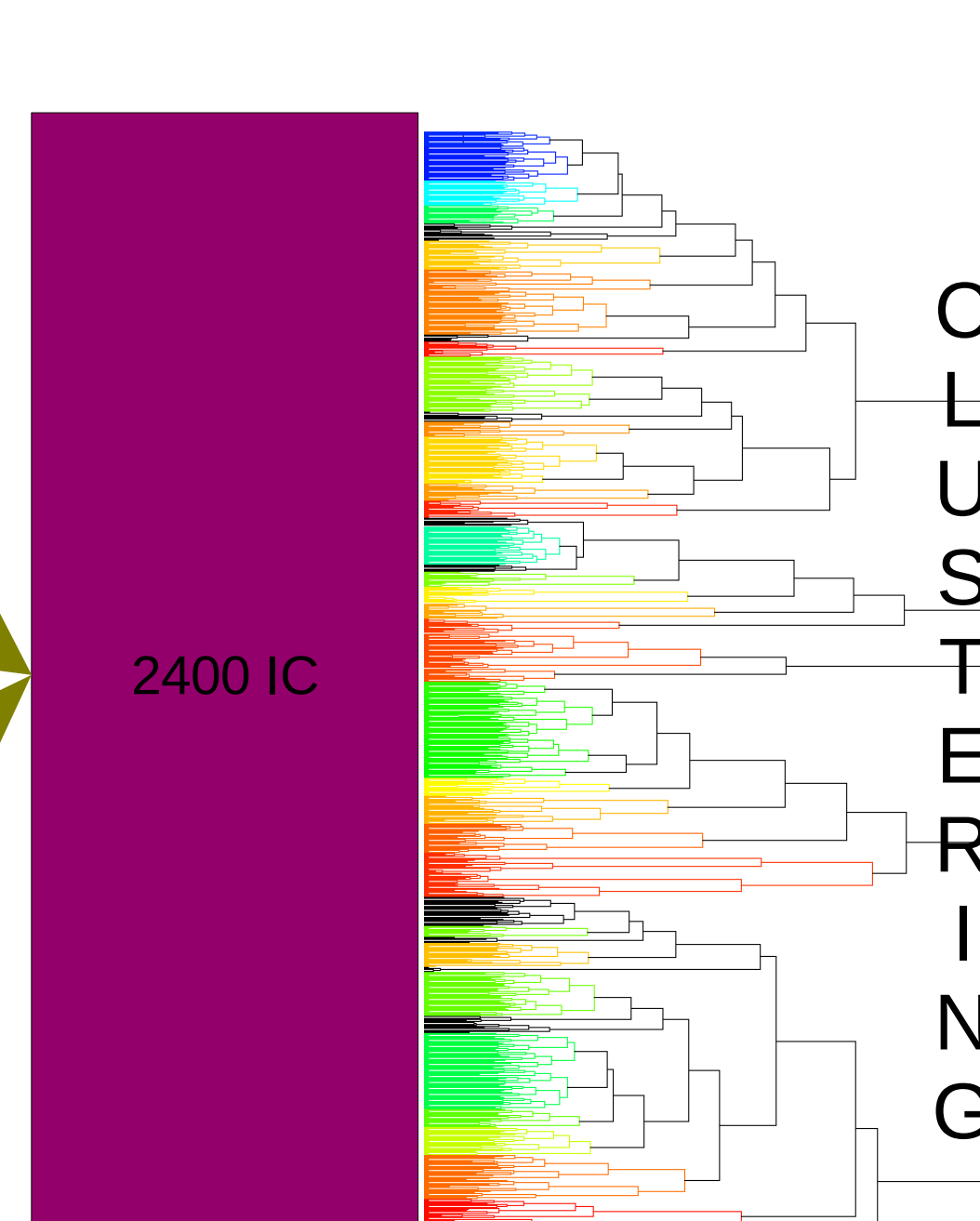
Method :

- **Projection** on MNI cortex
- **Hierarchical clustering** minimizing distance between components
- Extraction of classes using **representativity** and **unicity** in the population
- Thresholded **t-score maps** for each class

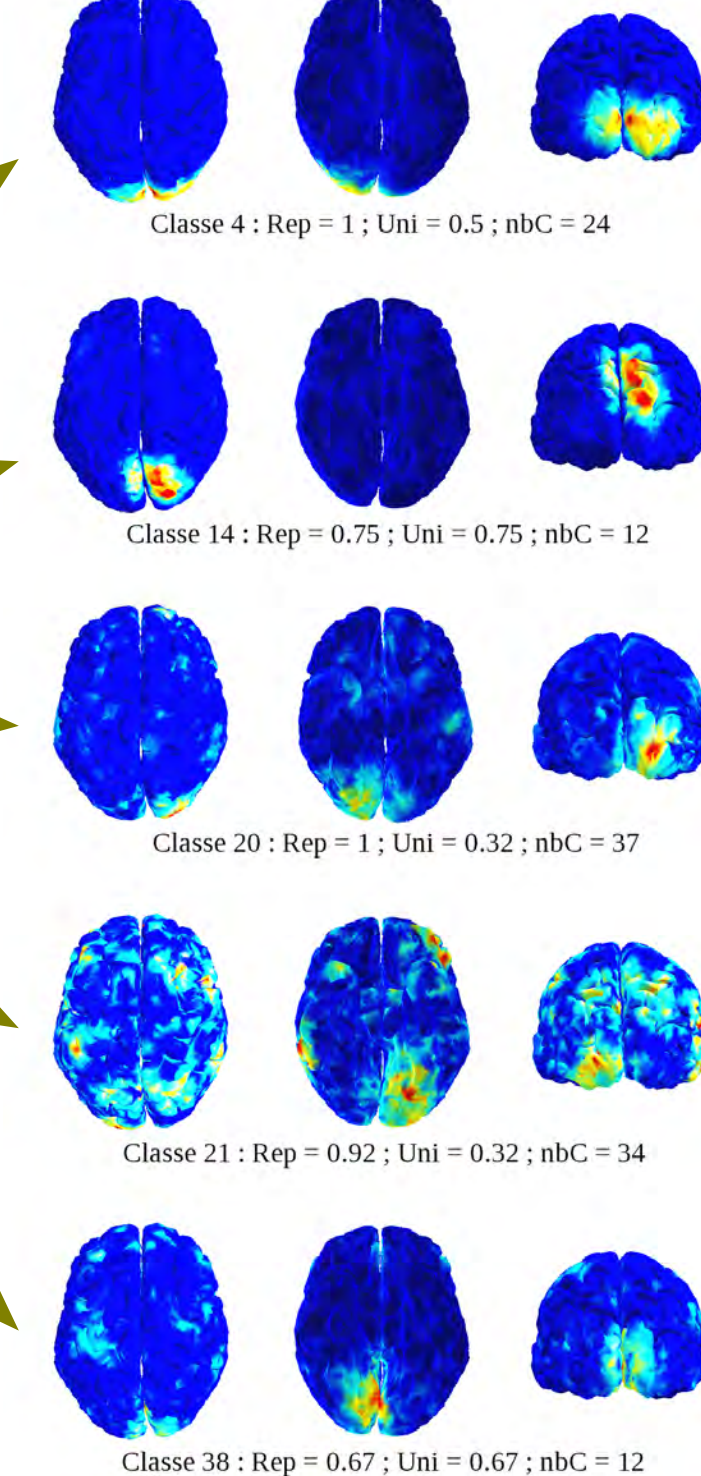
Results of individual sICA



Projected IC on MNI cortex



Obtained EEG Classes



Comparison with fMRI

Question :

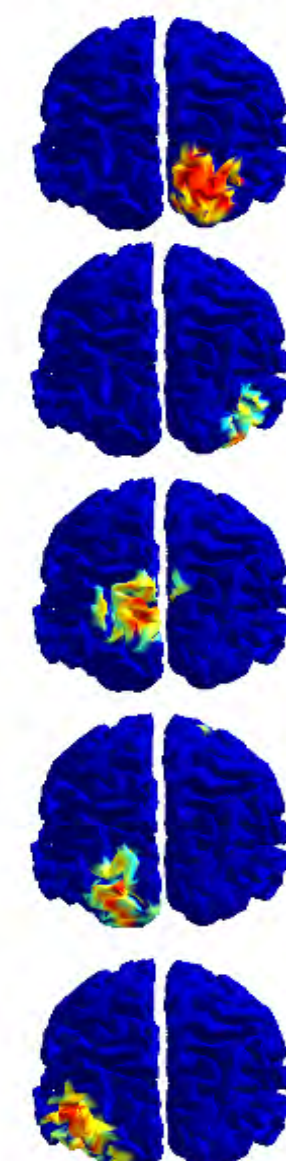
Does the EEG and MRI share the same structural functional information ?

Method :

- fMRI raw data **interpolation** on the cortical surface [4]
- **Stepwise regression** between EEG classes and fMRI networks
- **F-test** between the results in the 2 modalities (p-value results) :

tâches	Réseaux		
	moteur	visuel	mode par défaut
Repos 1	0.3353	0.3216	0.3605
Repos 2	0.3534	0.3023	0.2672
Repos 3	0.2467	0.4275	0.3090
visuelle	0.5152	0.5161	0.4290

Classes EEG



R
E
G
R
E
S
S
I
O
N

réseau
reconstruit
EEG

réseau
visuel

réseau
mode par
défaut

réseau
Moteur

réseau
visuel

réseau
Moteur

réseau
visuel

réseau
Moteur

Conclusion & Perspectives

We develop a sICA method for EEG to detect functional networks.

Originality :

- Data driven method
- Spatial dimension in the ICA
- Multifrequency analysis
- Individual analysis and group clustering

Results :

- Good match between fMRI and EEG networks

Perspectives :

- Improve selection of components
- Analysis of the frequency signature of the EEG networks
- Connectivity studies within the networks (coherency, Granger causality,...)

REFERENCES :

- [1] Sockeel et al : IRBM 2011; 32:35-41
- [2] Perlberg et al. : Int J Biomed Imaging. 2008; 218519.
- [3] Laufs et al : NeuroImage 2003; 19:1463 – 1476
- [4] Grova et al : NeuroImage 2006; 31:1475 – 1486

SOFTWARES :

- <http://brainvisa.info/>
<http://neuroimage.usc.edu/brainstorm>
<http://sites.google.com/site/netbrainwork/>