Clustering of ICA components

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Steps of clustering

- Select ICA components for clustering
- Precompute measures of interest
- Cluster measures
- Plot clusters and edit them if necessary
Edit dataset info

Create a new STUDY set -- pop_study()

Edit STUDY set information - remember to save changes
- STUDY set name: Sternberg
- STUDY set task name: Sternberg
- STUDY set notes:

<table>
<thead>
<tr>
<th>dataset filename</th>
<th>browse</th>
<th>subject</th>
<th>session</th>
<th>condition</th>
<th>group</th>
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Important note: Removed datasets will not be saved before being deleted from EEGLAB memory

- Dataset info (condition, group, ...) differs from study info. [set] = Overwrite dataset info.
- Delete cluster information (to allow loading new datasets, set new components for clustering, etc.)

pop_study(): Pre-select components
- Enter maximum residual (topo map - dipole proj.) var. (in %)
- NOTE: This will delete any existing component clusters!
- 15
- Keep only in-brain dipoles.
- Cancel
- Help
- Ok
Computing residual variance (%)

\[ r = \frac{\sum (x_i - \tilde{x}_i)^2}{\sum x_i^2} \]
Reliability criteria and the r.v <15%

First justification why we should select an r.v <15% for components to include in further analyses: there is a forbidden region underlined in red, that indicates the absence of artifact or mixing of multiple processes.

A

Quality Index and Dipolarity above Retention threshold: Good

CLASS I

CLASS II

Quality Index above threshold, dipolarity below: artifact or mixing of multiple processes

CLASS III

Quality Index below retention threshold

B


dip ± std > th

Probable Inseparable noise: variance
explained useful or
multiple subject
confirmation

dip ± std < th

Discard
ICs to cluster
Precompute data measures
Pre-compute measures
Precompute data measures

TIP: Compute all measures so you can test different combinations for clustering
Cluster components
Precluster schematic

ERSP (time/freq)

Mean ERSPs

ICs (all subj)

PCA

# PCs

PC templates

Power spectrum

Mean spectra

ICs (all subj)

PCA

# PCs

PC templates

3D dipole position

ICs (all subj)

x3

3D dipole moments

ICs (all subj)

x3

ICs (all subj)
ICs (all subj)

Mean ERSPs

PCs

PC templates

Mean spectra

ICs (all subj)

3D dipole position

ICs (all subj)

3D dipole moments

ERSP

PC weights

Spectrum

Dip. positions

Dip. moments

PC weights

Ics/PCs (all subj)
Precluster: Use singular values from PCA

Mean ERSPs

ICs (all subj)

PCA

Mean ERSPs

PC templates

# PCs

Normalized singular values

~ relative variance of principal components

10% of max singular value
Precluster schematic

ICs (all subj)

ERSP

Spectrum

Dipoles

Each component is a dot. Clustering will group these dots.
1. k initial "means" (in this case k=3, shown in color) are randomly selected from the data set (shown in grey).

2. k clusters are created by associating every observation with the nearest mean.

3. The centroid of each of the k clusters becomes the new means.

4. Steps 2 and 3 are repeated until convergence has been reached.
Cluster components
Subject differences?

Significant ITC differences (by bootstrap) between the LOC and fLOC clusters immediately follow Probe presentation (5-11 Hz).
Results (Cluster 1 within subject)

100 % Sessions contribute
Results (Cluster 2 within subject)

100 % Sessions contribute
Results (Cluster 8 within subject)

100 % Sessions contribute
Results (Cluster 13 within subject)

63.64% Sessions contribute
Results (Cluster 14 within subject)

36.36% Sessions contribute
Left $\mu$ cluster (across subjects)
Right $\mu$ cluster

S1 IC51

S3 IC41

S5 IC51

S7 IC48

S11 IC49

S2 IC41

S4 IC50

S6 IC6^0

S9 IC39

S14 IC49

Power (dB)

Frequency (Hz)
Occipital $\alpha$ cluster
Frontal Midline θ cluster

S1 IC63
S9 IC16
S12 IC15
S2 IC18
S11 IC16
S13 IC15
S14 IC16
View and edit clusters
Plot/edit clusters

View and edit current component clusters -- pop_clustedit()

Study name: 'Sternberg' (336 of 336 components clustered)

Select cluster to plot
- All cluster centroids
- ParentCluster 1 (336 ICs)
  - Cls 2 (17 ICs)
  - Cls 3 (6 ICs)

Select component(s) to plot
- 'Cls 2' comp. 1 (S01 IC21)
- 'Cls 2' comp. 2 (S03 IC21)
- 'Cls 2' comp. 3 (S03 IC25)
- 'Cls 2' comp. 4 (S04 IC19)

Plot scalp maps
Plot dipoles
Plot ERPs
Plot spectra
Plot ERSPs
Plot ITCs
Plot cluster properties

Params

Create new cluster
Rename selected cluster
Merge clusters

Reassign selected component(s)
Remove selected outlier comps.
Auto-reject outlier components

Help
Cancel
Ok
Plot cluster data

Study 'Attention': 181 of 181 components clustered

Select cluster to plot
- All cluster centroids
- ParentCluster 1 (181 ICs)
- outlier 2 (1 ICs)
- Cls 3 (5 ICs)

Select component(s) to plot
- 'outlier 2' comp. 1 (S12 IC12)
- 'Cls 3' comp. 1 (S01 IC11)
- 'Cls 3' comp. 2 (S05 IC11)
- 'Cls 3' comp. 3 (S06 IC15)

- Plot scalp maps
- Plot dipoles
- Plot ERPs
- Plot spectra
- Plot ERSPs
- Plot ITCs
- Plot cluster properties
- Create new cluster
- Rename selected cluster
- Merge clusters

Plot mean scalp maps for easy reference
Plot cluster data

Choose which cluster

Choose which components
Plot cluster data
Plot cluster data

Select design: memorize vs ignore

Select cluster to plot:
- All cluster centroids
- ParentCluster 1 (311 ICs)
- Cls 2 (26 ICs)
- Cls 3 (15 ICs)
- Cls 4 (24 ICs)
- Cls 5 (14 ICs)

Select component to plot:
- All components
- S01 IC6
- S01 IC8
- S02 IC6
- S02 IC23
- S02 IC49

Options:
- Plot dipoles density
- Plot projection lines
- Plot dipoles projections
- Plot closest MRI slide

Chart showing brain activity maps.
Plot cluster ERP
Exercise

• Load the STUDY stern.study
• Precompute spectrum and scalp maps for components
• Precluster and cluster components using dipole locations and dipole moments (affinity clustering)
• Look at your cluster. Identify frontal midline theta cluster(s) and occipital alpha cluster(s)
• Remove outliers if any
• Plot significant difference (parametric statistics) for one component cluster spectrum between the two conditions ignore vs memorize