STUDY analysis

Task 1
Cluster ERP image (IC polarity)

Task 2
Cluster cross coherence

Task 3
Dipole density

Exercise...
STUDY analysis

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Exercise...
Cluster ERP image

**Purpose** of ERP image:
- Observe single-trial dynamics of an IC activation (or power)

**Purpose** of CLUSTER ERP image:
- Observe single-trial dynamics of multiple *matched* ICs from several subjects

Two approaches:
- Average ERP images across ICs
- Merge trials across ICs
Cluster ERP image: match polarity

reversed polarities reflect mismatched scalp maps

reorienting maps and activations gives a more coherent picture
Movie of IC scalp map over time

Potential (uV)

Time (ms)

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Matching activation polarity

EEGLAB STUDY matches polarities for you
Matching activation polarity

However, original IC maps/activations may be opposite within a cluster:

Reversed polarity
Matching activation polarity

Reorient map AND activation of one IC to align
Cluster ERP image: RT sort

Consistent scalp maps

Sort cluster ERP image by response time

Consistent activations
STUDY analysis

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Exercise...
Cross coherence between clusters requires 2 clusters with common subjects
STUDY cross coherence

\[
\text{clust1} = 6;
\]
\[
\text{clust2} = 23;
\]
% Crossf parameters:--------------------------------

\[
\text{type} = '\text{phasecoher}';
\]
\[
\text{alpha} = .01;
\]
\[
\text{cycles} = [3 0.5]; \text{ % wavelet cycles}
\]
\[
\text{freqscale} = '\text{log}';
\]
\[
\text{frqlim} = [3 30]; \text{ % calculation frequency limits in Hz}
\]
\[
\text{tmlims} = [-100 1000]; \text{ % [min max] times in ms for window}
\]
for cond = 1:size(STUDY.cluster(clust1).sets,1)
    ttls = cell(1,0); allrts = cell(1,0); p=1;
    for ic = 1:length(STUDY.cluster(clust1).comps)
        setidx = STUDY.cluster(clust1).sets(cond,ic);
        comp1 = STUDY.cluster(clust1).comps(ic);
        [ALLEEG EEG CURRENTSET] = pop_newset(ALLEEG, EEG, CURRENTSET,...
            'retrieve', setidx, 'study', CURRENTSTUDY);
        subjmatch = find(STUDY.cluster(clust2).sets(cond,:) == setidx);
        for c = 1:length(subjmatch)
            comp2 = STUDY.cluster(clust2).comps(subjmatch(c));
            [coh( ::, ::, p), mcoh, times, freqs, cohboot( ::, p), cohang( ::, ::, p)] = ... 
                newcrossf(EEG.icaact(comp1,:), EEG.icaact(comp2,:),... 
                    EEG.pnts, [EEG.xmin*1000 EEG.xmax*1000], EEG.srate, cycles,... 
                        'alpha', alpha, 'winsize', EEG.srate, 'newfig', 'off', ... 
                            'type', type, 'freqs', frqlim, 'freqscale', freqscale,... 
                                'savecoher', 0 , 'plotamp' , 'off', 'plotphase' , 'off' );
            p = p+1;
            ttls{end+1} = [STUDY.datasetinfo(setidx).subject,': ICs ',...
                int2str(comp1),'-',int2str(comp2)];
        end;
    end;
condcohs{cond} = coh;
condboots{cond} = cohboot;
condang{cond} = cohang;
end;
Task 4: Cross coherence between clusters

```matlab
figure;
imagesclogy(times,freqs,mean(coh,3));
set(gca,'ydir','norm');hold on;
plot([0 0],[get(gca,'ylim')],'k-');

title(['Cluster ',...
int2str(clusts(1)),' vs cluster ',...
int2str(clusts(2))]);

% include a colorbar
% for coh values:
cbar;
```

Gives average phase coherence between members of two different IC clusters.
STUDY analysis

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Exercise...
Dipole density plotting

**PURPOSE:** to visualize distributions of dipoles in ‘MRI-esque’ way

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**Broadband gamma IMs used for classification**

<table>
<thead>
<tr>
<th>dipoles/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
</tr>
<tr>
<td>38</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>-2</td>
</tr>
<tr>
<td>-22</td>
</tr>
</tbody>
</table>

---

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Explanation of ‘method’ argument

'method' - ['alldistance'|'distance'|'entropy'|'relentropy'] method for computing density:

'alldistance' - {default} take into account the gaussian-weighted distances from each voxel to all the dipoles. See 'methodparam' (below) to specify a standard deviation (in mm) for the gaussian weight kernel.

'distance' - take into account only the distances to the nearest dipole for each subject. See 'methodparam' (below).

'entropy' - taking into account only the nearest dipole to each voxel for each subject. See 'methodparam' below.

'relentropy' - as in 'entropy,' but take into account all the dipoles for each subject.
cond = 1;   clust = 3;
dipsources = struct('posxyz',[],'momxyz',[],'rv',[]);   n = 1;
nowidx = 0; % initialize
for ic = 1:length(STUDY.cluster(clust).comps)
    setidx = STUDY.cluster(clust).sets(cond,ic);
    comp = STUDY.cluster(clust).comps(ic);
    if setidx ~= nowidx % don't call in if already active
        [ALLEEG EEG CURRENTSET] = pop_newset(ALLEEG, EEG, CURRENTSET, ...
            'retrieve',setidx, 'study',CURRENTSTUDY);  nowidx = setidx;
    end;
    model = EEG.dipfit.coordformat;
    dipsources(1,n).posxyz = EEG.dipfit.model(comp).posxyz;
    dipsources(1,n).momxyz = EEG.dipfit.model(comp).momxyz;
    dipsources(1,n).rv = EEG.dipfit.model(comp).rv;  n = n + 1;
end;
dipoledensity(dipsources , 'method','alldistance','methodparam',10,...
    'coordformat',model);
Exercise

- **ALL**
  - Load workshop STUDY

- **Novice**
  - Load and plot individual ERSPs for one or more clusters.
  - How consistent are the ERSPs in these clusters?

- **Intermediate**
  - Pick a cluster to investigate
  - Plot mean power in a small time/frequency window across all ICs and conditions for this cluster

- **Advanced**
  - Plot ERP image for a cluster sorting for response time (Probe).
  - Try a dipole density plot for one or more clusters of interest
    - try plotting different MRI slices to better view cluster

** All scripts for Intermediate/Advanced exercises can be found in ...
../workshop/Scripts/Tutorial_9_STUDYanalysis_II.m