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
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

Consistent activations

Sort cluster ERP image by response time
STUDY analysis

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

clust1 = 6;
clust2 = 23;

% Crossf parameters:--------------------------------
type = 'phasecoher';
alpha = .01;
cycles = [3 0.5]; % wavelet cycles
freqscale = 'log';
frqlim = [3 30]; % calculation frequency limits in Hz
tmlims = [-100 1000]; % [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,'frequ','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;
endcohs{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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Dipole density

Exercise...
**Dipole density plotting**

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

**Template strength (a.u.)**

138 IMs 86%

**Frequency (Hz)**

10 30 60 100

**Gamma**

F-std: 2.1

**Broadband gamma IMs used for classification**

<table>
<thead>
<tr>
<th>58</th>
<th>38</th>
<th>18</th>
<th>-2</th>
<th>-22</th>
</tr>
</thead>
</table>

**dipoles/cm³**

0.0012 0.0006 0.00006 0.00000
Dipole density plotting

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