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%%%%%%%%%
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%%%%%%%%%                ERP                %%%%%%%%%
%%%%%%%%%                Lecturer:Dr.Soltani                %%%%%%%%%
%%%%%%%%%                %%%%%%%%%                %%%%%%%%%
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```

Load in EEG data and make time vector.

```

clear ;
close all;
clc;

load ERP_data.mat;
time=-200:5:1000;

```

Average re-referencing.

```

average_channels=mean(data,1);
data_rereference=data-average_channels;

```

Find event.

```

event_index=zeros(30,4);
event_timepoint=zeros(30,4);
epoch=cell(1,4);

event_sample=cell2mat(struct2cell(event));
event_sample=squeeze(event_sample(1,:,:));

% I use latency row of event data
event_time=cell2mat(struct2cell(event));
event_time=squeeze(event_time(2,:,:));

event_class=unique(event_sample);

```

Epoching between -200 to 1000 ms.

```

event_class_target=event_class(1:4);
for i=1:size(event_timepoint,2)
    event_index(:,i)=find(event_sample==event_class_target(i));
    event_timepoint(:,i)=event_time(event_index(:,i));
    for j=1:size(event_timepoint,1)

        epoch{i}(:, :, j)=data_rereference(:, (event_timepoint(j,i)-40:event_timepoint(j,
        %200 samples after events is my epoch(see next section)
        % 50 samples before events is my baseline.
        % total 250 samples (1 second)
    end
end

```

```

epoch{i}(:, :, j) = epoch{i}(:, :, j) - mean(epoch{i}(:, 1:50, j), 2); %Baseline correction
end
end

```

Which channel do you want to plot "all epochs"?

```

which_stimulus=1; % 111 112 121 122
which_channel=30; % you can change it!

```

ERP.

```

ERP=cell(1,4);
for i=1:size(event_timepoint,2)
    ERP{i}=mean(epoch{i},3);
end

```

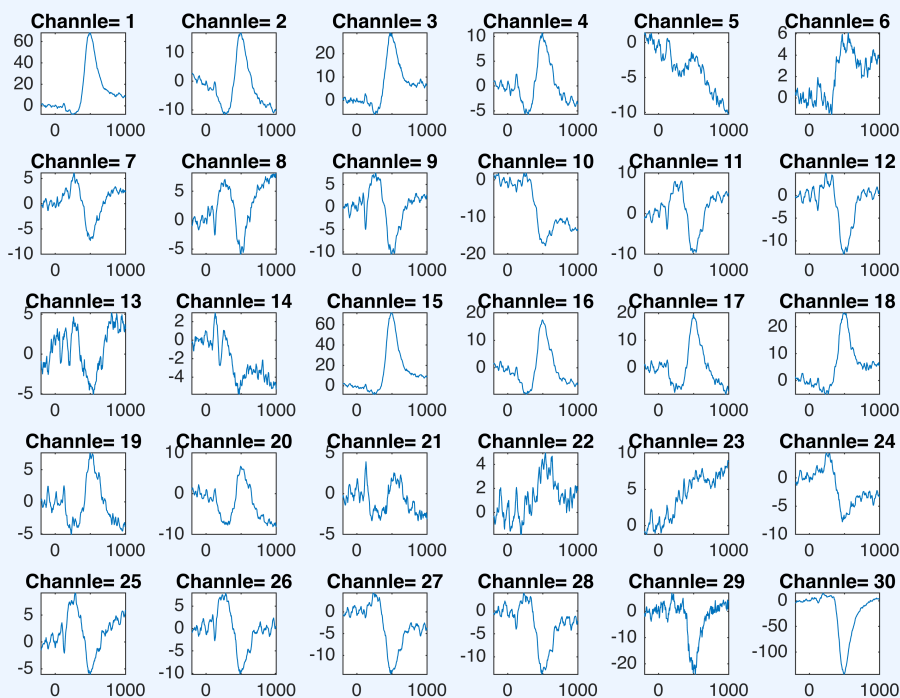
Plot all ERP per channel.

```

for j=1:size(event_timepoint,1)
    hold off;
    subplot(5,6,j);
    plot(time,ERP{which_stimulus}(j,:));
    title(['Channel= ' num2str(j) ]);
end
sgtitle(['ERPs per channel' ' (Event '...
        num2str(event_class(which_stimulus)) ' ']);

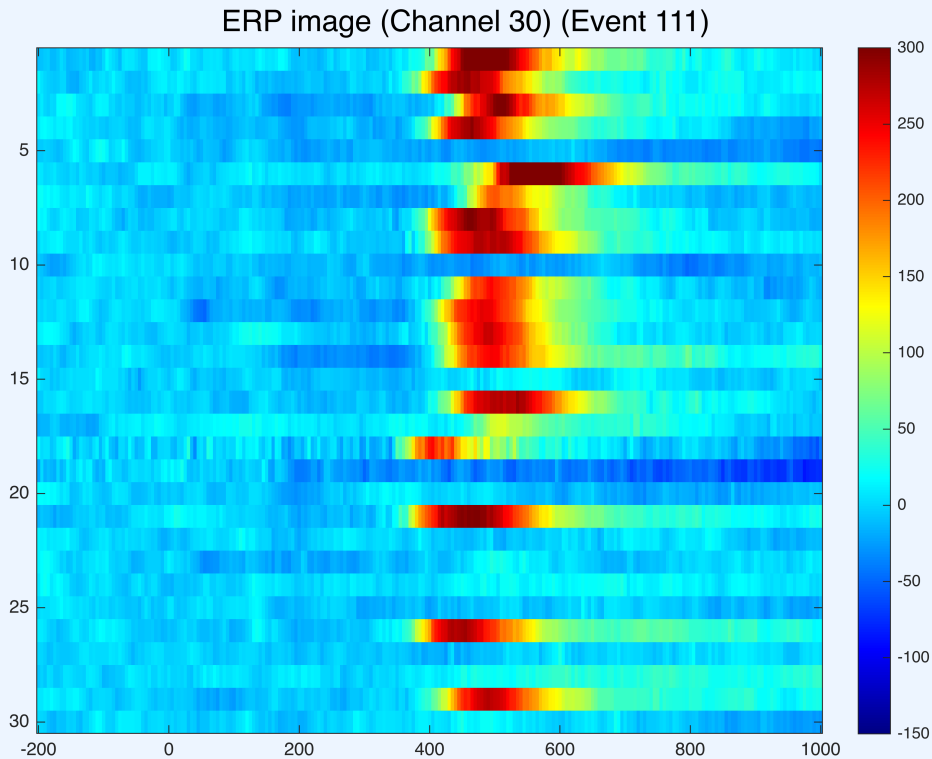
```

ERPs per channel (Event 111)



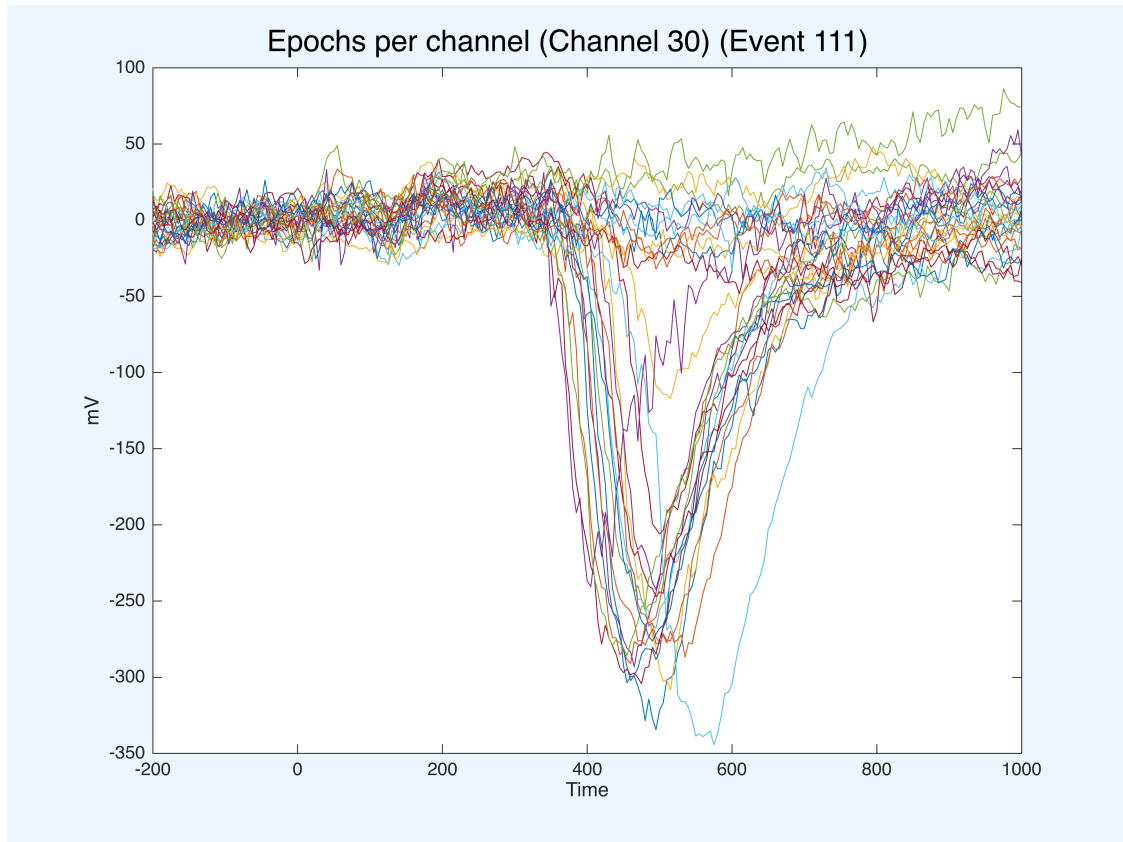
ERP image.

```
clf;
imagesc(time,flip(1:size(epoch,3)),-squeeze(epoch{which_stimulus}(which_channle,:,:)')
colorbar;
sgtitle(['ERP image (Channel ' num2str(which_channle) ') ' (Event ' ...
        num2str(event_class(which_stimulus)) ')'])
set(gca,'clim',[-150 300])
```



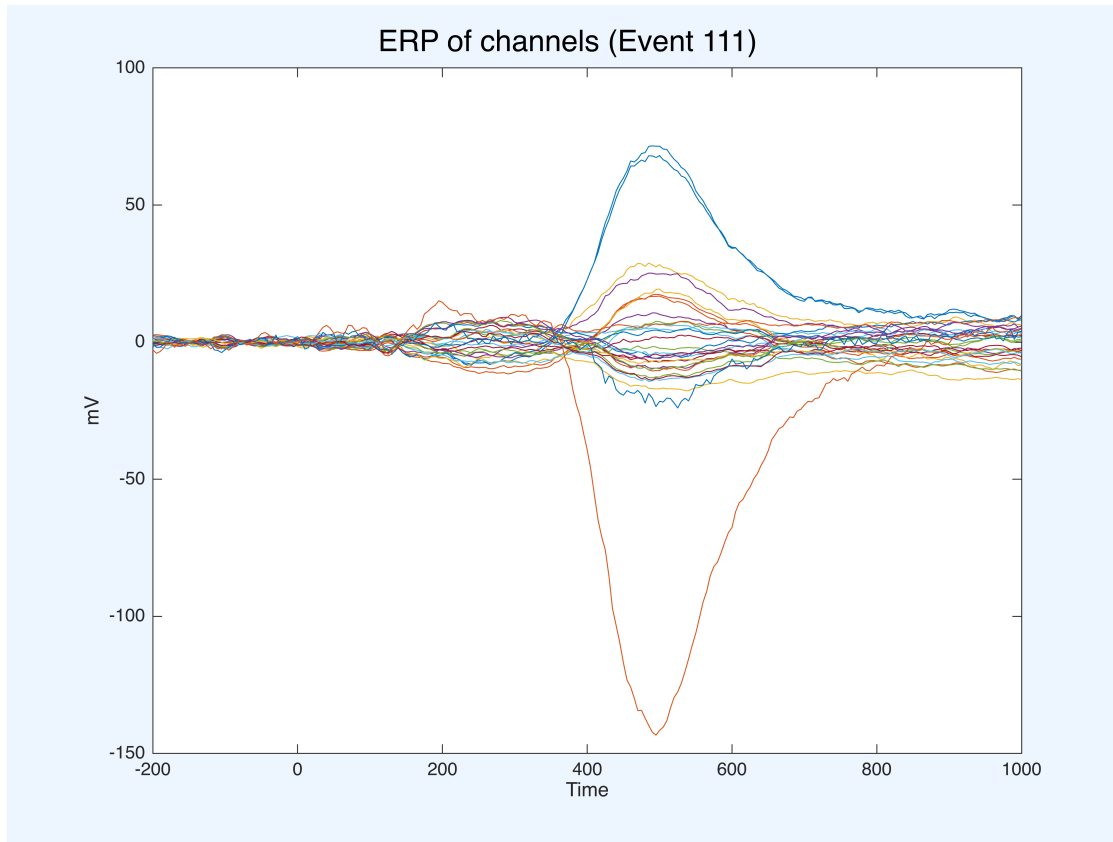
Plot all epochs per channle.

```
clf;
plot(time,squeeze(epoch{which_stimulus}(which_channle,:,:)'));
sgtitle(['Epochs per channel (Channel ' num2str(which_channle) ') ' (Event ' ...
        num2str(event_class(which_stimulus)) ')'])
xlabel('Time')
ylabel('mV')
```



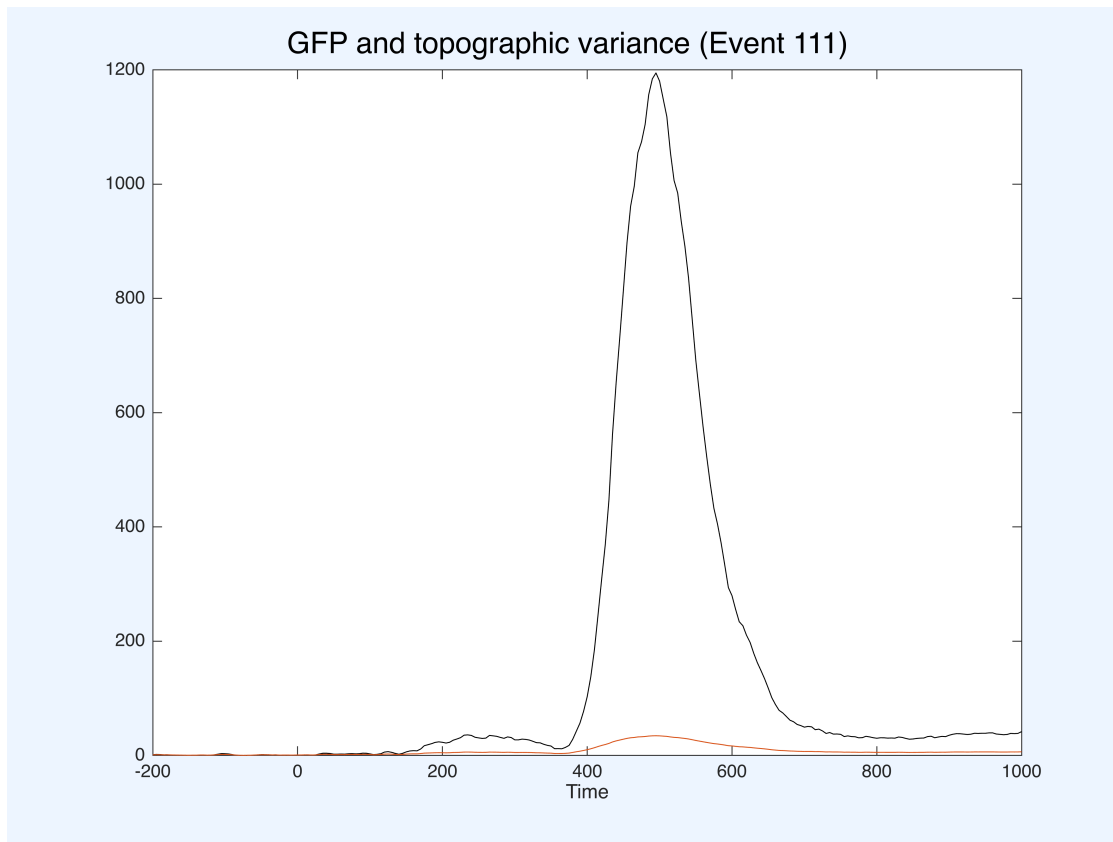
ERPs in one plot.

```
clf;  
plot(time,ERP{which_stimulus});  
sgtitle(['ERP of channels' ' (Event ' ...  
    num2str(event_class(which_stimulus)) ')]);  
xlabel('Time')  
ylabel('mV')
```



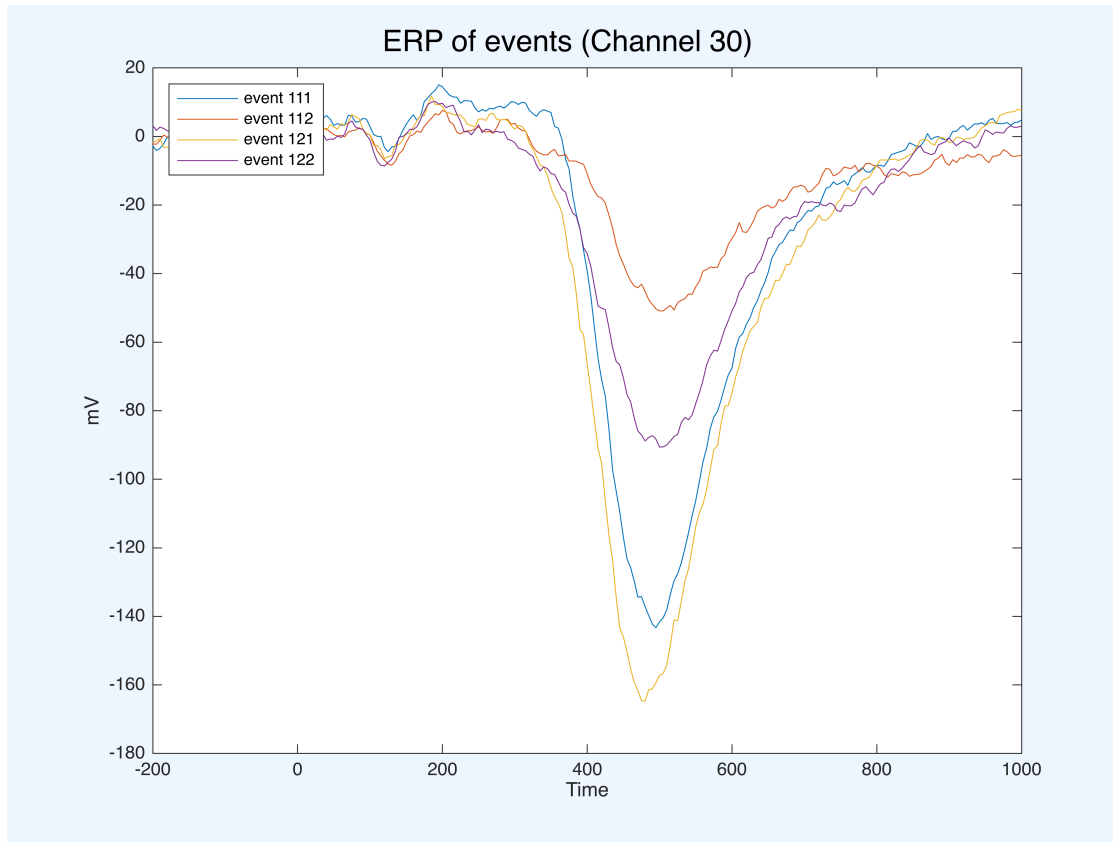
GFP.

```
clf;
gfp = std(ERP{which_stimulus});
varians=var(ERP{which_stimulus});
plot(time, varians , 'k');
hold on;
plot(time, gfp);
xlabel('Time')
sgtitle(['GFP and topographic variance' ' (Event ' ...
        num2str(event_class(which_stimulus)) ' ')]);
```



ERPs of events.

```
clf;
for j=1:size(event_timepoint,2)
    plot(time,ERP{j}(which_channle,:));
    hold on
end
sgtitle(['ERP of events ' '(Channel ' num2str(which_channle) ')']);
xlabel('Time')
ylabel('mV')
legend('event 111','event 112','event 121','event 122', 'Location','northwest');
```



Topoplot of ERPs.

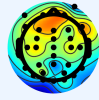
```
clf;
for i=1:16
    subplot(4,4,i);
    topoplot(-ERP{which_stimulus}(:,((i*8)+37)),chanlocs);
    %I use (i+5)*10) for skip pre-stimulus samples.
    % I use - for invers color of plot!
    title(['Time= +' num2str(time((i*8)+37))]);
end
sgtitle('topoplot of ERPs')
```

topoplot of ERPs

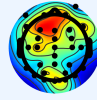
Time= +20



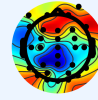
Time= +60



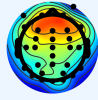
Time= +100



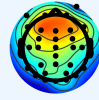
Time= +140



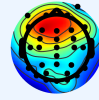
Time= +180



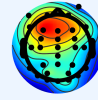
Time= +220



Time= +260



Time= +300



Time= +340



Time= +380



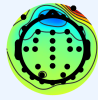
Time= +420



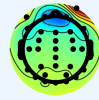
Time= +460



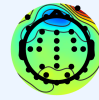
Time= +500



Time= +540



Time= +580



Time= +620

