ABSTRACT

Data Analysis for P300 data set including spatial averaging of parietal channels

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1. First extract single trials after stimulus and Plot

In order to extract single trials after stimulus following steps were used :

1. Loading data set into workspace
2. Selecting channel 5 and Reducing Data dimension from 85x7794x64 in variable Signal to 26x1 using `squeeze(Signal(1,5,39:end,1)) %26 points from Subject A, channel 5, trial 3`
3. Saving the reduced data in variable `SingleStimulus`
4. Plotting the signal
5. Plotting square Signal
6. Repeat steps 1-5 for each data set train/test
7. Repeat steps 1-5 for both subjects A and B

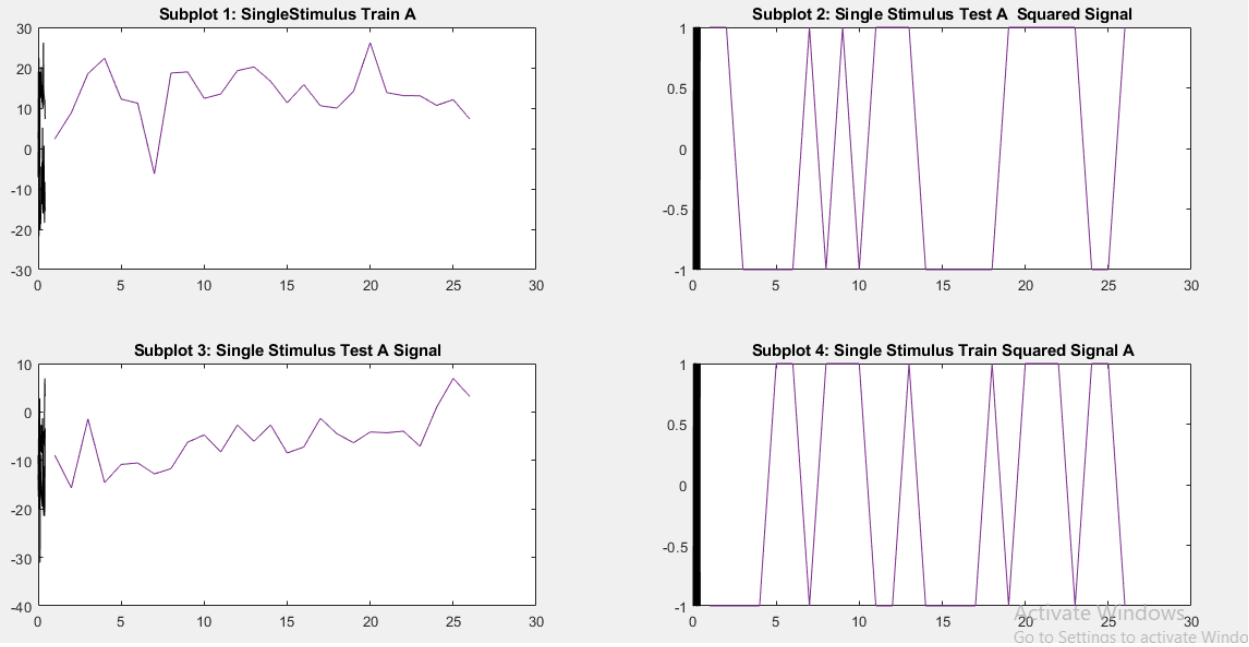
Matlab Commands Subject A:

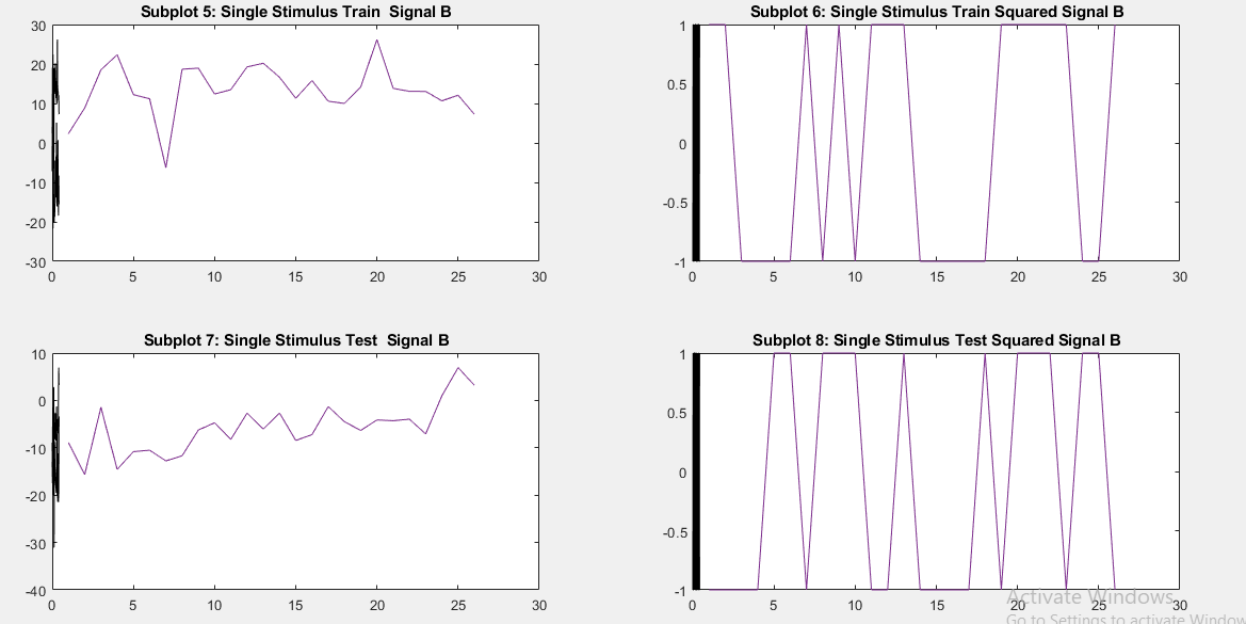
```
load('Subject_A_Train.mat')
frequency_s=60; % Setting the frequency to 60 Hz
%  points from Subject A, channel 5, trial 3
singleStimulus_Train_A = squeeze(Signal(1,5,39:end,1))
N=length(singleStimulus_Train_A); % Get length of average per 5
trails
t=(0:N-1)/frequency_s; % Generating time vector

subplot(2,2,1)% Generating SingleStimulus Train A Plot
plot(t,singleStimulus_Train_A,'k');hold on;
title('Subplot 1: SingleStimulus Train A')

subplot(2,2,2)% Generating Single Stimulus Test A  Squared Signal
Plot
plot(t,square(singleStimulus_Train_A),'k');hold on;
title('Subplot 2: Single Stimulus Test A  Squared Signal')

load('Subject_A_Test.mat')
singleStimulus_Test_A = squeeze(Signal(1,5,39:end,1))
N1=length(singleStimulus_Test_A); % Get length
t1=(0:N1-1)/frequency_s; % Generating time vector
subplot(2,2,3)
plot(t1,singleStimulus_Test_A,'k');hold on;
title('Subplot 3: Single Stimulus Test A Signal')

subplot(2,2,4)
plot(t1,square(singleStimulus_Test_A),'k');hold on;
title('Subplot 4: Single Stimulus Train Squared Signal A')
```

Matlab Commands Subject B:

```
load('Subject_B_Train.mat')
singleStimulus_Train_B = squeeze(Signal(1,5,39:end,1))
N2=length(singleStimulus_Train_B); % Get length
t2=(0:N2-1)/frequency_s; % Generating time vector

subplot(2,2,1)
plot(t2,singleStimulus_Train_B,'k');hold on;
title('Subplot 5: Single Stimulus Train  Signal B')

subplot(2,2,2)
plot(t2,square(singleStimulus_Train_B),'k');hold on;
title('Subplot 6: Single Stimulus Train Squared Signal B')

load('Subject_B_Test.mat')
singleStimulus_Test_B = squeeze(Signal(1,5,39:end,1))
N3=length(singleStimulus_Test_B); % Get length
t3=(0:N3-1)/frequency_s; % Generating time vector
subplot(2,2,3)
plot(t2,singleStimulus_Test_B,'k');hold on;
title('Subplot 7: Single Stimulus Test  Signal B')
subplot(2,2,4)
plot(t2,square(singleStimulus_Test_B),'k');hold on;
title('Subplot 8: Single Stimulus Test Squared Signal B')
```

Plots Subject A and Subject B





2. Take averaging of 5 trails and plot

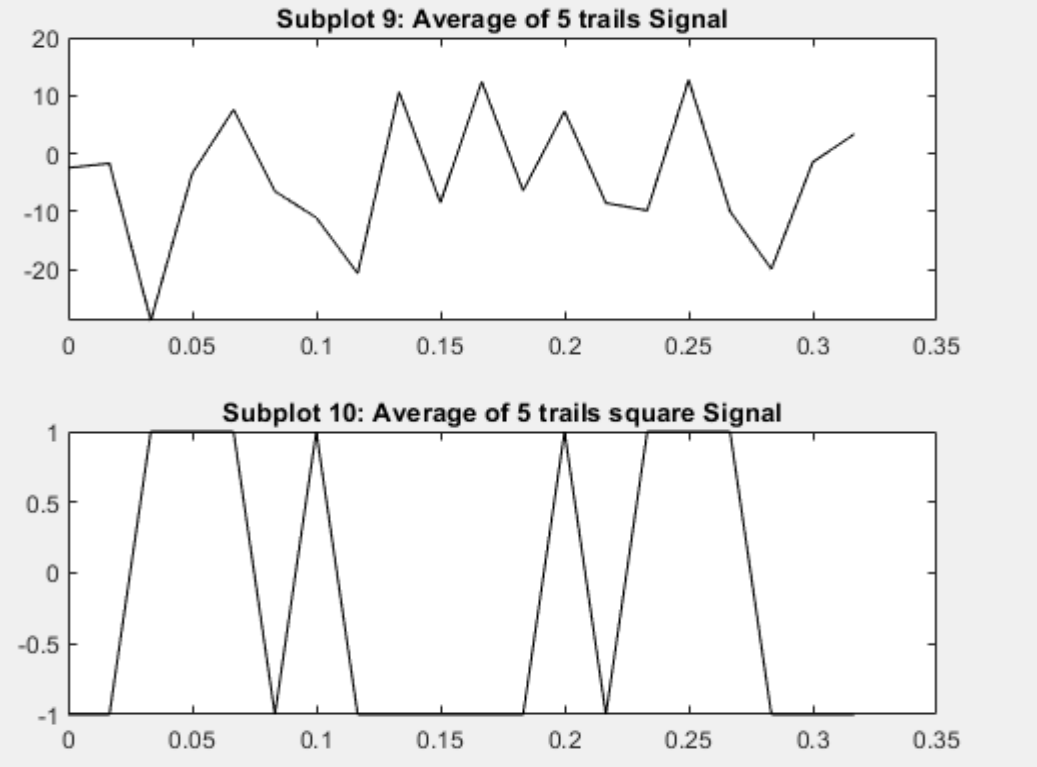
In order to take average of 5 trials and plot following steps were used :

1. Loading data set into workspace
2. Selecting 5 trails by using values 1-5 and taking their mean, next using next 5 values and taking their mean and so on using `reshape(column2(1:100), [], 5)`
3. Saving the reduced data in variable `out`
4. `Taking mean(out, 2)`
5. Plotting the signal
6. Plotting square Signal
7. Repeat steps 1-4 for each data set train/test
8. Repeat steps 1-5 for both subjects A and B

Matlab Commands :

```
column2 = Signal;
out = reshape(column2(1:100), [], 5)
N=length(out); % Get length of average per 5 trails
frequency_s=60; % Setting the frequency to 60 Hz

t=(0:N-1)/frequency_s; % Generating time vector
means5 = mean(out, 2)
subplot(2,1,1)
plot(t,means5,'k');hold on;
title('Subplot 9: Average of 5 trails Signal')
```

Plots

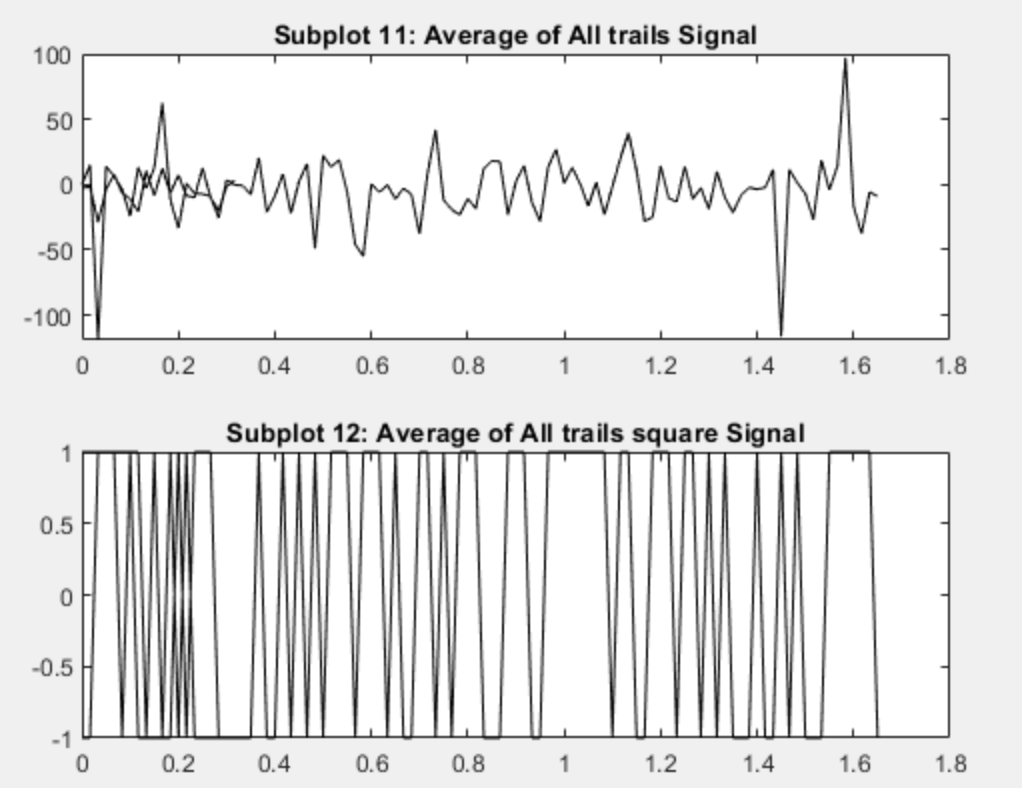


3. Take averaging to all trials from single channel and plot

Matlab Commands :

```
column2 = Signal;
out = reshape(column2(1:100), [], 1)
N=length(out); % Get length of average per 5 trails
frequency_s=60; % Setting the frequency to 60 Hz

t=(0:N-1)/frequency_s; % Generating time vector
means5 = mean(out, 2)
subplot(2,1,1)
plot(t,means5,'k');hold on;
title('Subplot 11: Average of All trails Signal')
```

Plots

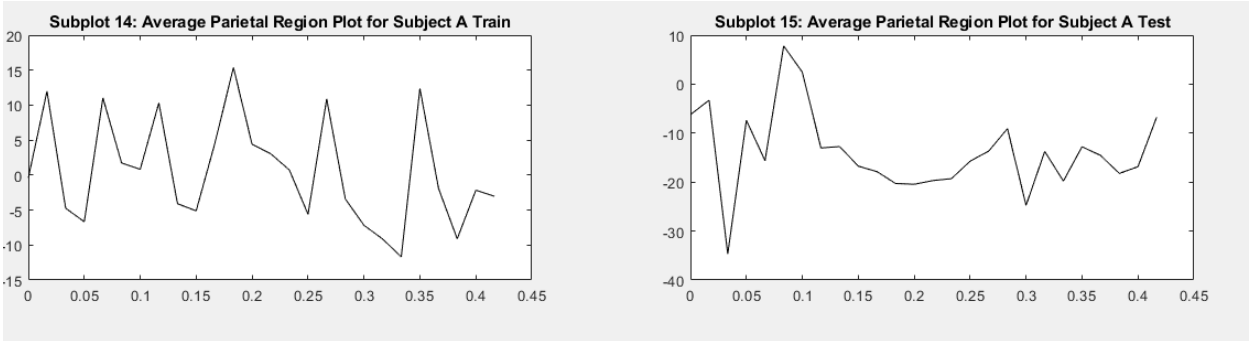

Subplot 11: Average of All trails Signal
100
50
0
-50
-100
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Subplot 12: Average of All trails square Signal
1
0.5
0
-0.5
-1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

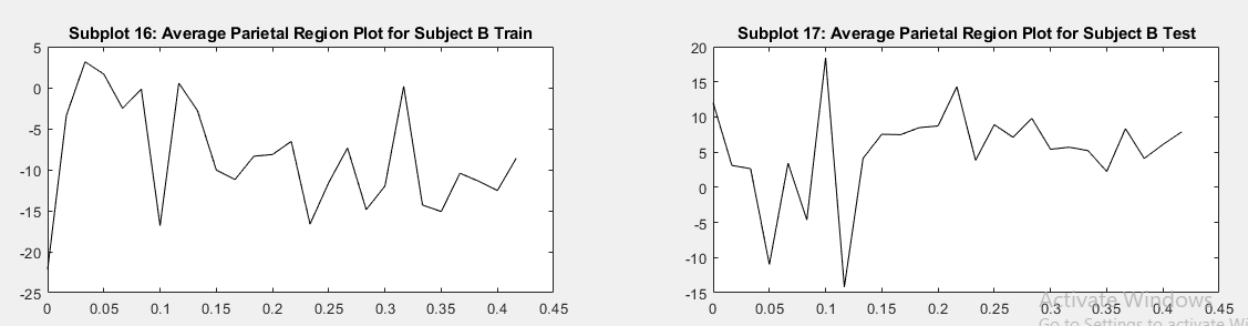
1. Average the parietal region channels and find the spatial averaging of all trials.

```
load('Subject_A_Train.mat')
frequency_s=60; % Setting the frequency to 60 Hz
%  points from Subject A, channel 5, trial 3
48,49,53,54
singleStimulus_Train_A_P5 =
squeeze(Signal(1,48,39:end,1))
singleStimulus_Train_A_P3 =
squeeze(Signal(1,49,39:end,1))
singleStimulus_Train_A_P4 =
squeeze(Signal(1,53,39:end,1))
singleStimulus_Train_A_P6 =
squeeze(Signal(1,54,39:end,1))
N=length(singleStimulus_Train_A_P5); % Get length
t=(0:N-1)/frequency_s; % Generating time vector
singleStimulus_Train_A_parietal_avg=(singleStimulus_Tr
ain_A_P5+singleStimulus_Train_A_P3+singleStimulus_Trai
n_A_P4+singleStimulus_Train_A_P6)/4
subplot(2,2,1)% Generating SingleStimulus Train A Plot
plot(t,singleStimulus_Train_A_parietal_avg,'k');hold
on;
title('Subplot 14: Average Parietal Region Plot for
Subject A Train')


load('Subject_A_Test.mat')
frequency_s=60; % Setting the frequency to 60 Hz
%  points from Subject A, channel 5, trial 3
48,49,53,54
singleStimulus_Test_A_P5 =
squeeze(Signal(1,48,39:end,1))
singleStimulus_Test_A_P3 =
squeeze(Signal(1,49,39:end,1))
singleStimulus_Test_A_P4 =
squeeze(Signal(1,53,39:end,1))
singleStimulus_Test_A_P6 =
squeeze(Signal(1,54,39:end,1))
N=length(singleStimulus_Test_A_P5); % Get length
t=(0:N-1)/frequency_s; % Generating time vector
singleStimulus_Test_A_parietal_avg=(singleStimulus_Tes
t_A_P5+singleStimulus_Test_A_P3+singleStimulus_Test_A_
P4+singleStimulus_Test_A_P6)/4
subplot(2,2,2)% Generating SingleStimulus Train A Plot
plot(t,singleStimulus_Test_A_parietal_avg,'k');hold
on;
title('Subplot 15: Average Parietal Region Plot for
Subject A Test')
```

```
load('Subject_B_Train.mat')
frequency_s=60; % Setting the frequency to 60 Hz
%  points from Subject A, channel 5, trial 3 48,49,53,54
singleStimulus_Train_B_P5 = squeeze(Signal(1,48,39:end,1))
singleStimulus_Train_B_P3 = squeeze(Signal(1,49,39:end,1))
singleStimulus_Train_B_P4 = squeeze(Signal(1,53,39:end,1))
singleStimulus_Train_B_P6 = squeeze(Signal(1,54,39:end,1))
N=length(singleStimulus_Train_B_P5); % Get length
t=(0:N-1)/frequency_s; % Generating time vector
singleStimulus_Train_B_parietal_avg=(singleStimulus_Train_B
_P5+singleStimulus_Train_B_P3+singleStimulus_Train_B_P4+sin
gleStimulus_Train_B_P6)/4
subplot(2,2,3)% Generating SingleStimulus Train A Plot
plot(t,singleStimulus_Train_B_parietal_avg,'k');hold on;
title('Subplot 16: Average Parietal Region Plot for Subject
B Train')


load('Subject_B_Test.mat')
frequency_s=60; % Setting the frequency to 60 Hz
%  points from Subject A, channel 5, trial 3 48,49,53,54
singleStimulus_Test_B_P5 = squeeze(Signal(1,48,39:end,1))
singleStimulus_Test_B_P3 = squeeze(Signal(1,49,39:end,1))
singleStimulus_Test_B_P4 = squeeze(Signal(1,53,39:end,1))
singleStimulus_Test_B_P6 = squeeze(Signal(1,54,39:end,1))
N=length(singleStimulus_Test_B_P5); % Get length
t=(0:N-1)/frequency_s; % Generating time vector
singleStimulus_Test_B_parietal_avg=(singleStimulus_Test_B_P
5+singleStimulus_Test_B_P3+singleStimulus_Test_B_P4+singleS
timulus_Test_B_P6)/4;
subplot(2,2,4)% Generating SingleStimulus Train A Plot
plot(t,singleStimulus_Test_B_parietal_avg,'k');hold on;
title('Subplot 17: Average Parietal Region Plot for Subject
B Test')
```

Plots:

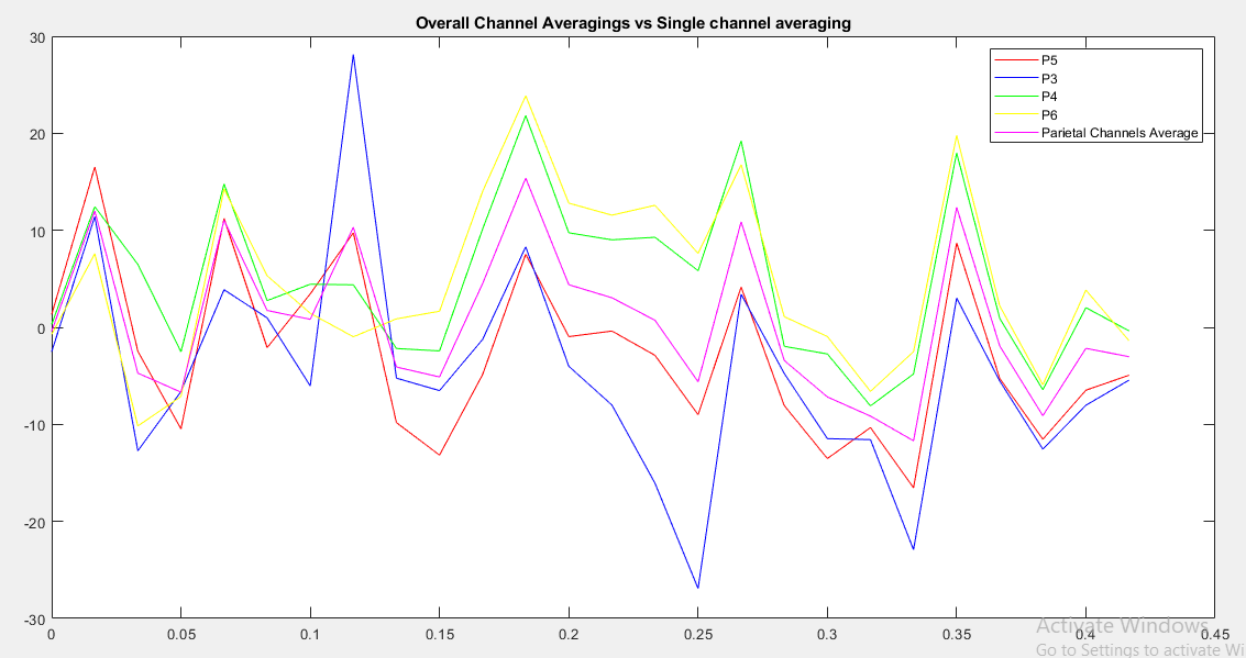




2. Find if single channel averaging is better than averaging over channels.

Matlab Code

```
load('Subject_A_Train.mat')
x = linspace(0,10,50);
frequency_s=60; % Setting the frequency to 60 Hz
%  points from Subject A, Parietal channels 48,49,53,54
singleStimulus_Train_A_P5 = squeeze(Signal(1,48,39:end,1))
singleStimulus_Train_A_P3 = squeeze(Signal(1,49,39:end,1))
singleStimulus_Train_A_P4 = squeeze(Signal(1,53,39:end,1))
singleStimulus_Train_A_P6 = squeeze(Signal(1,54,39:end,1))
N=length(singleStimulus_Train_A_P5); % Get length
t=(0:N-1)/frequency_s; % Generating time vector
% Sp Averaging
singleStimulus_Train_A_parietal_avg=(singleStimulus_Train_A_P
5+singleStimulus_Train_A_P3+singleStimulus_Train_A_P4+singleS
timulus_Train_A_P6)/4
% Comparison Plot
plot(t,singleStimulus_Train_A_P5,'c');hold on;
title('Overall Channel Averagings vs Single channel
averaging')
hold on

h1=plot(t,singleStimulus_Train_A_P5,'r');hold on;

h2=plot(t,singleStimulus_Train_A_P3,'b');hold on;

h3=plot(t,singleStimulus_Train_A_P4,'g');hold on;

h4=plot(t,singleStimulus_Train_A_P6,'y');hold on;

h5=plot(t,singleStimulus_Train_A_parietal_avg,'m');hold on;
legend([h1 h2 h3 h4 h5], 'P5', 'P3', 'P4','P6','Parietal
```



From the plot, the performance of the averaging over channels is significantly higher in comparison to individual channels. Standard deviation is lesser from the axis in cases of later

```
load('Subject_A_Train.mat')
%  points from Subject A, channel 5, trial 3 48,49,53,54
singleStimulus_Train_A_P5 = squeeze(Signal(1,48,39:end,1))
singleStimulus_Train_A_P3 = squeeze(Signal(1,49,39:end,1))
singleStimulus_Train_A_P4 = squeeze(Signal(1,53,39:end,1))
singleStimulus_Train_A_P6 = squeeze(Signal(1,54,39:end,1))

%  Standard deviation of individual  vs average of parietal channels

Standard_Deviation_P5 = std(singleStimulus_Train_A_P5)
Standard_Deviation_P3 = std(singleStimulus_Train_A_P3)
Standard_Deviation_P4 = std(singleStimulus_Train_A_P4)
Standard_Deviation_P6 = std(singleStimulus_Train_A_P6)
Standard_Deviation_Average = std(singleStimulus_Train_A_parietal_avg)
```

Standard_Deviation_P5 =8.5473

Standard_Deviation_P3 =10.8791

Standard_Deviation_P4 =8.0947

Standard_Deviation_P6 = 8.8262

Standard_Deviation_Average = 7.6199