Introductory Neuroscience & Neuro-Instrumentation
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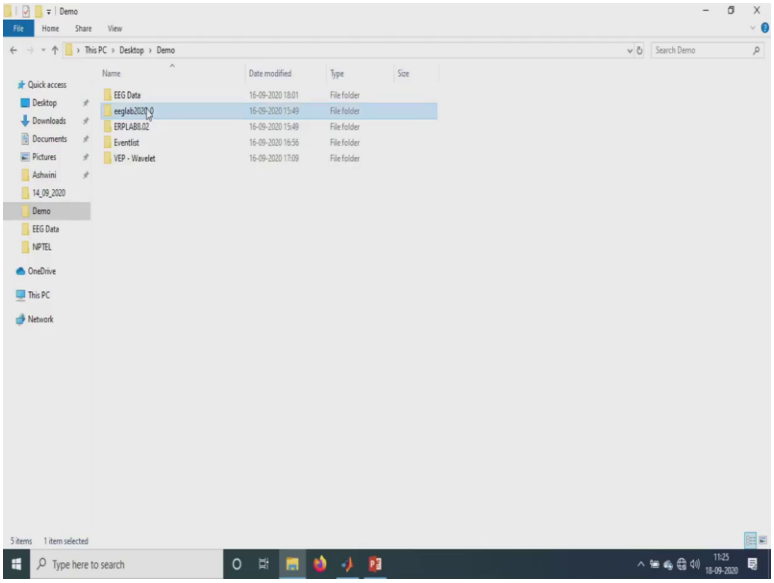
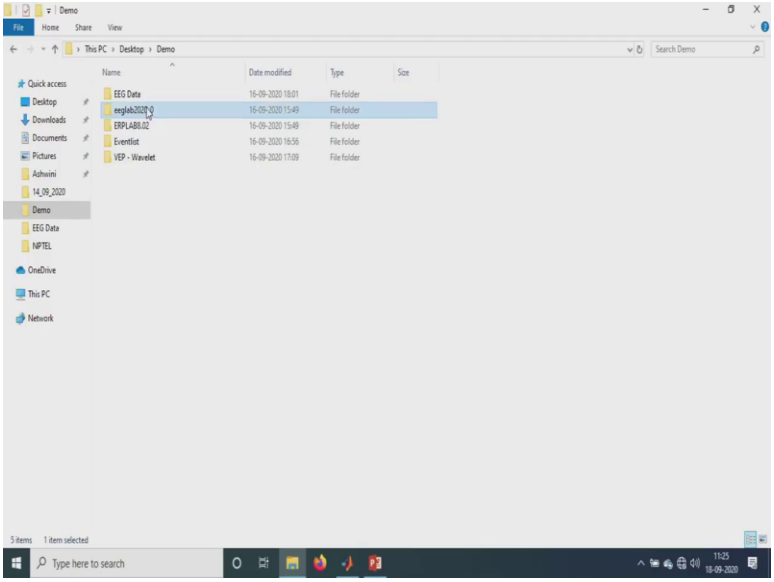
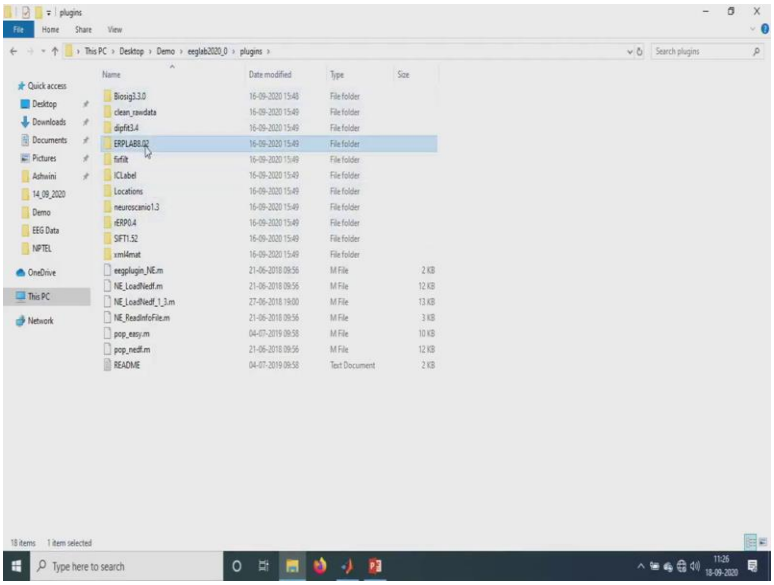
Indian Institute of Technology Bengaluru
Lecture 34
Introduction to EGLAB, ERPLAB and AEP Demonstration

Hello everyone. So, I will start with the auditory evoked potentials data analysis and processing using MATLAB with EEGLAB and ERPLAB. So, what we will do is, first we can obtain these EEGLAB and ERPLAB as, we can obtain that in the website, so we can just download it. And the most important thing about this is the ERPLABs it has to be copied inside.

(Refer Slide Time: 00:50)

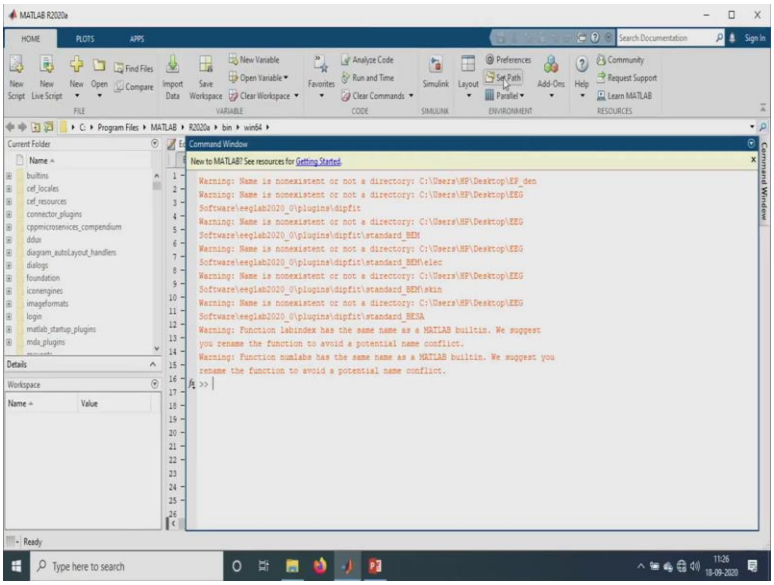


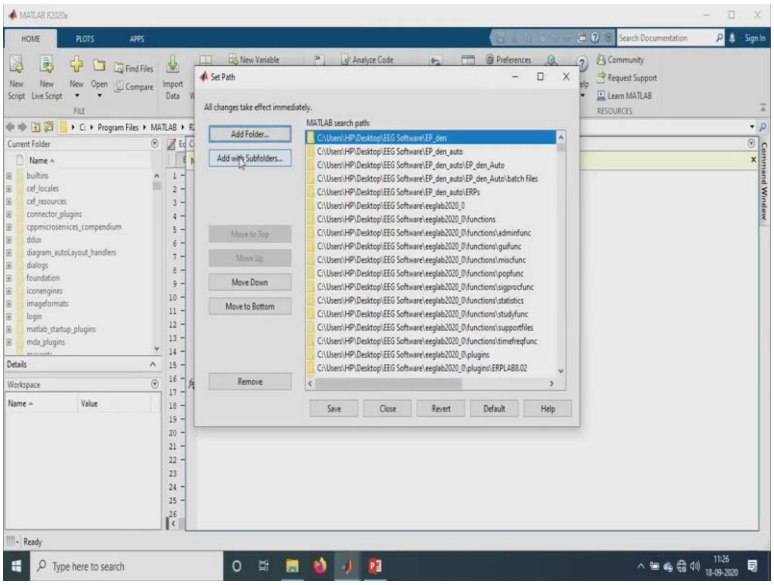


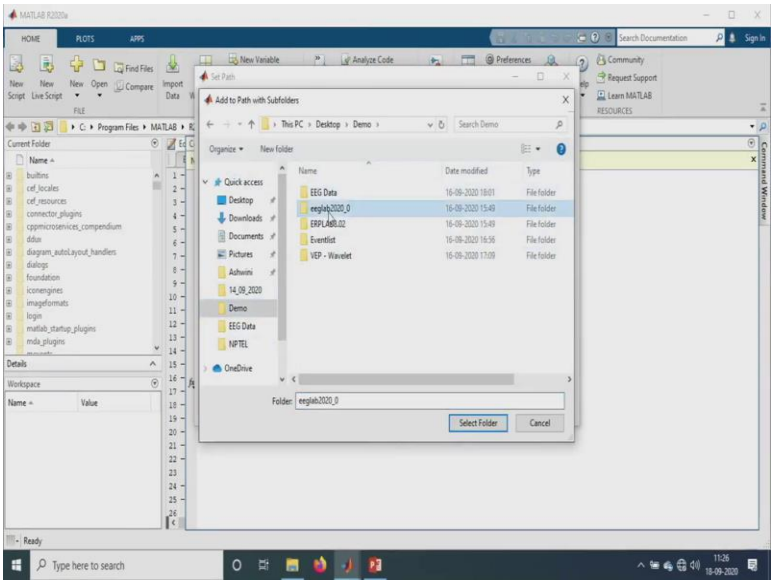


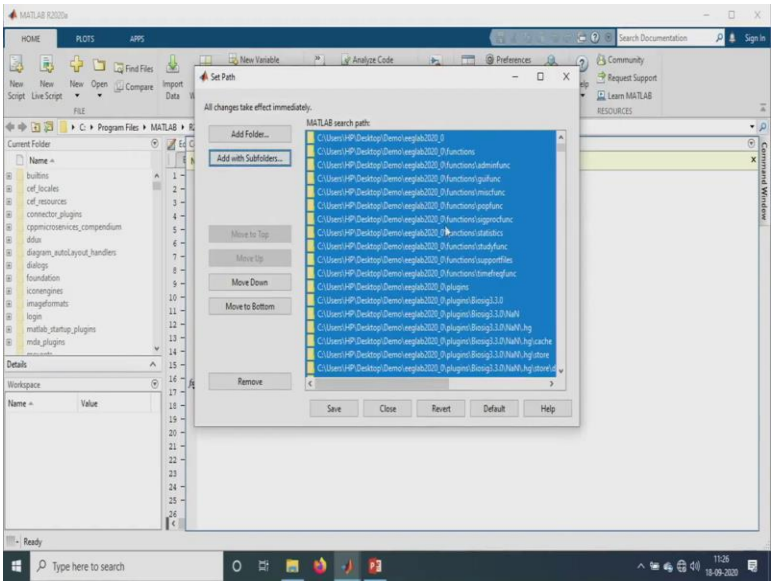
It has to be copied in such a manner that it should be placed inside the plugins of, the plugins of EEGLAB and so, here we have the ERPLABs pasted inside the plugins of the EEGLAB folder.

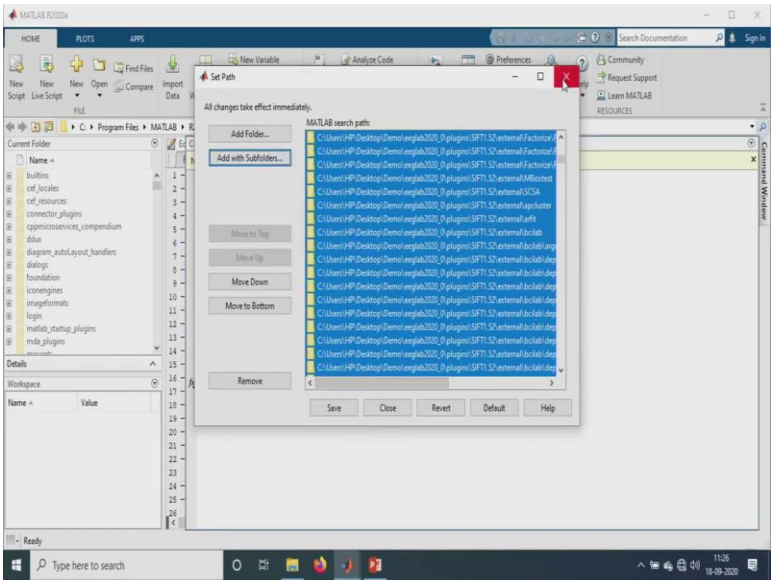
(Refer Slide Time: 01:10)




Set Path
All changes take effect immediately.
MATLAB search path:
Add Folder...
Add with Subfolders...
Move to Top
Move Up
Move Down
Move to Bottom
Remove
Save
Close
Revert
Default
Help

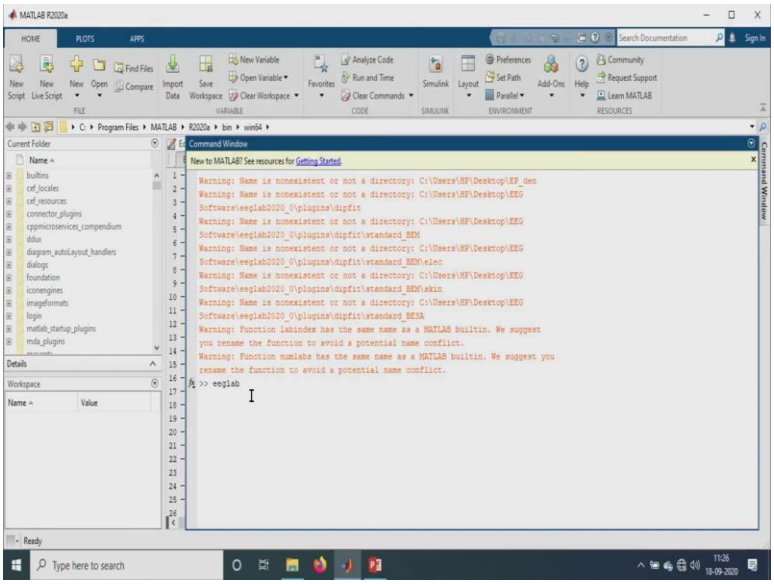

Add to Path with Subfolders
This PC › Desktop › Demo ›
Search Demo
Organize
New folder
Quick access
Desktop
Downloads
Documents
Pictures
Ashwini
14_08_2020
Demo
EEG Data
NPTEL
OneDrive
Name
Date modified
Type
EEG Data
eeglab2020_0
ERPLAB8.02
Eventlist
VEP - Wavelet
Folder: eeglab2020_0
Select Folder
Cancel

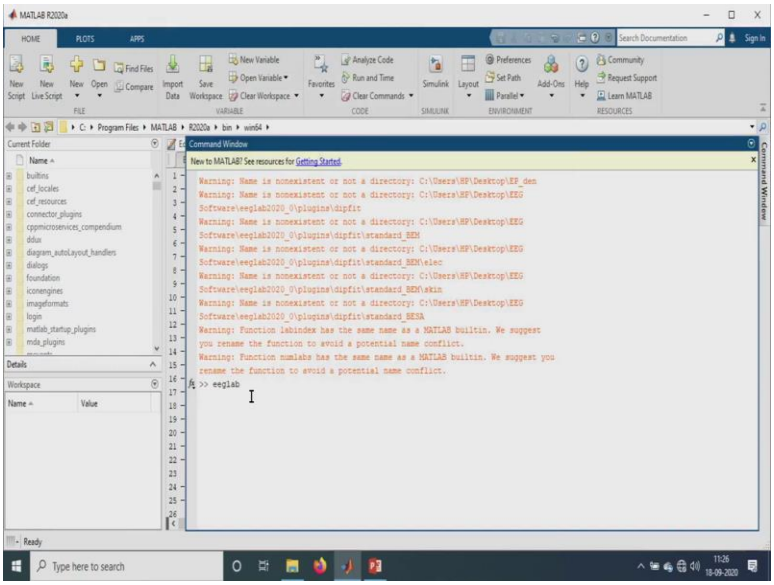


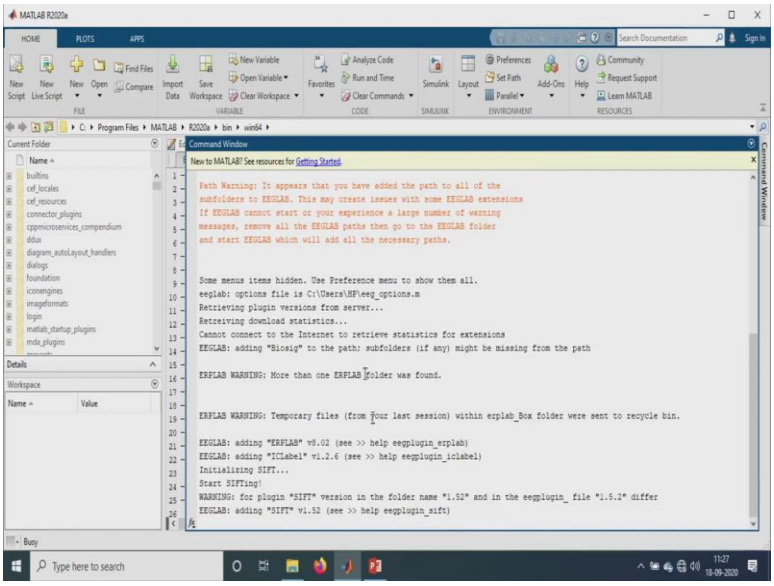


After that, the next thing which we have to do is we have to set the path inside this MATLAB. So, here we go inside here this option called as set path, and there we add this, add with subfolders the EEGLABs, this particular folder we will just open it, so that all the plugins along with the functions all the popup functions, all the different everything will be added into this and then we just save it and close. So, this is an important step before starting up with this EEGLAP and ERPLAB.

(Refer Slide Time: 01:46)

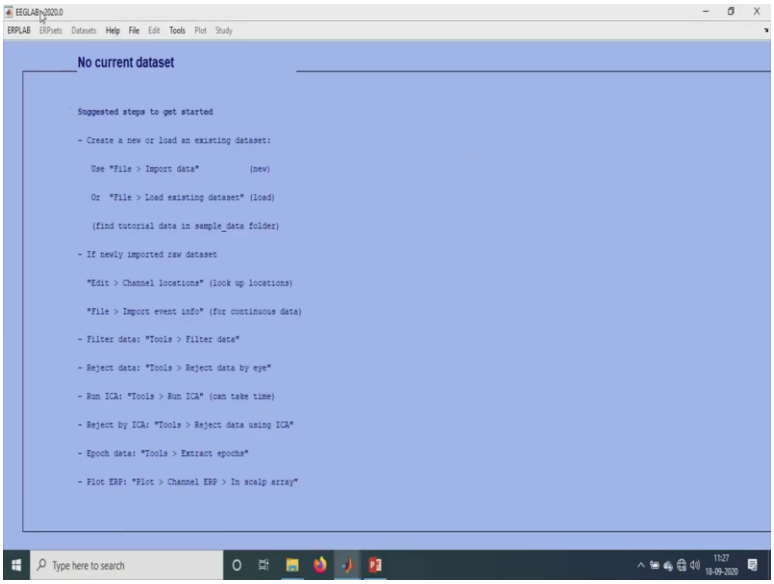


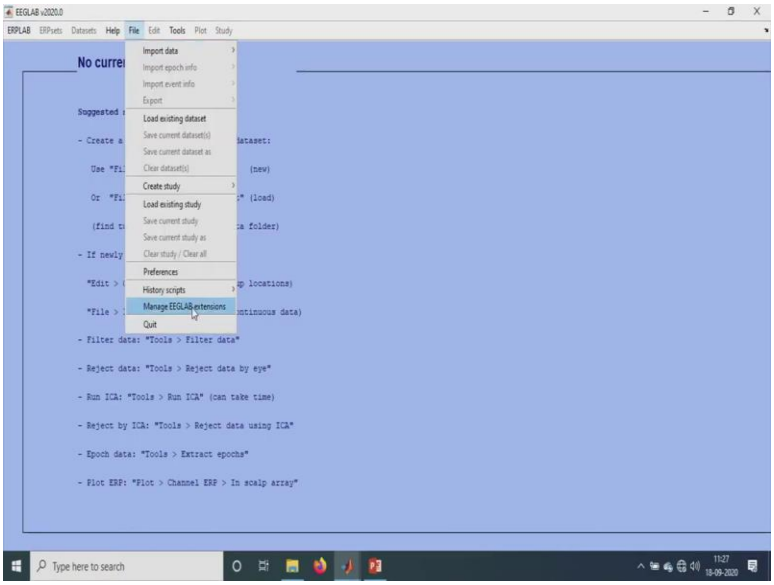


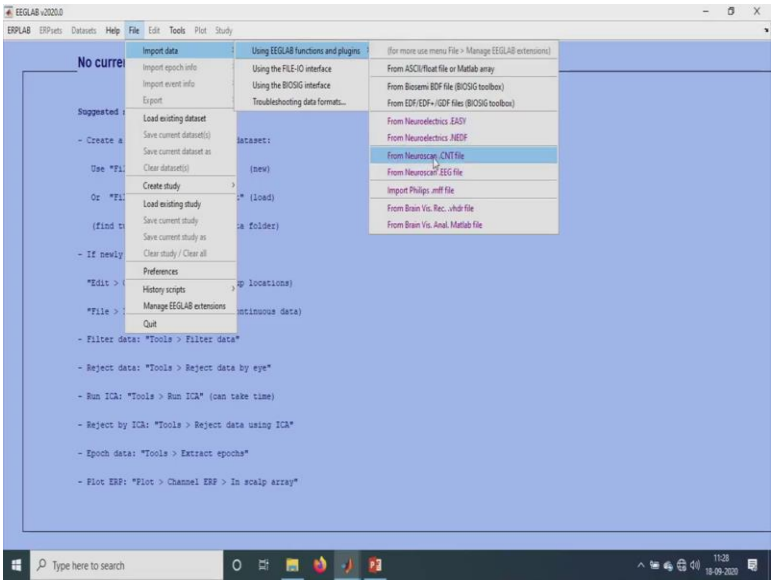


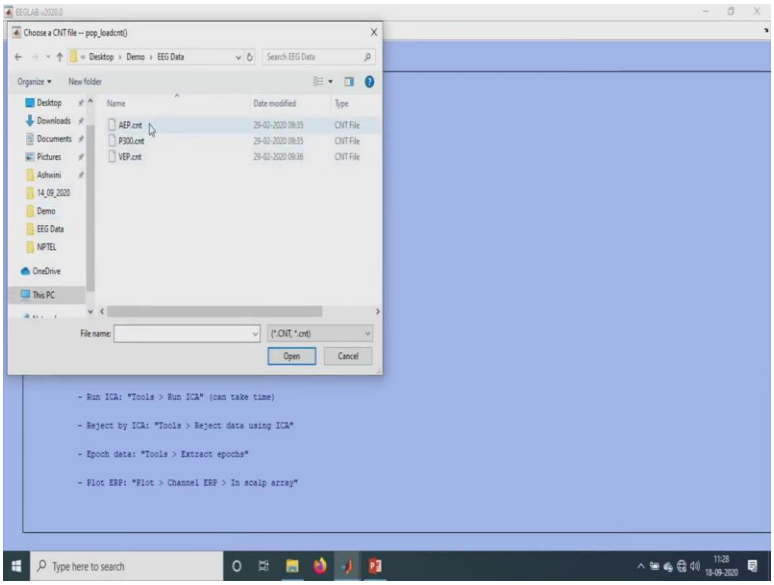
Then, then if you just after, after saving and saving it if you just put EEGLAB like that and it will, it will start running, like it starts working. So, it should start coming like this and you will get a graphical user interface.

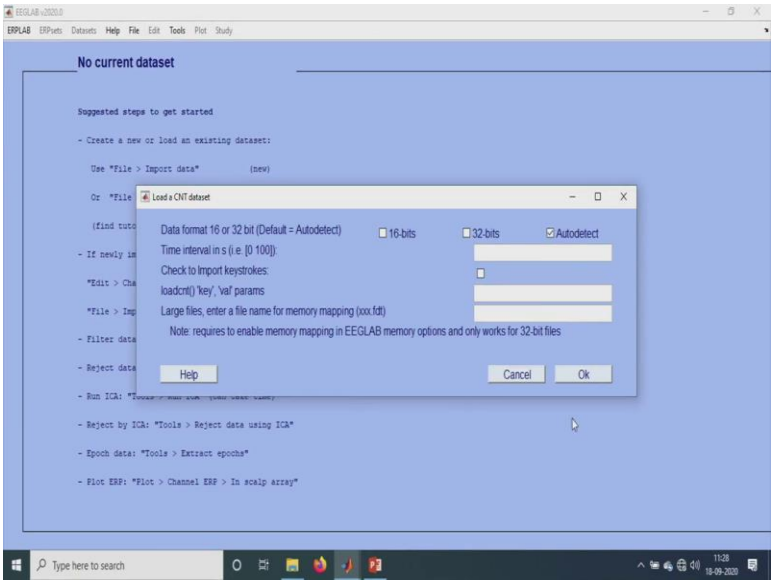
(Refer Slide Time: 02:12)

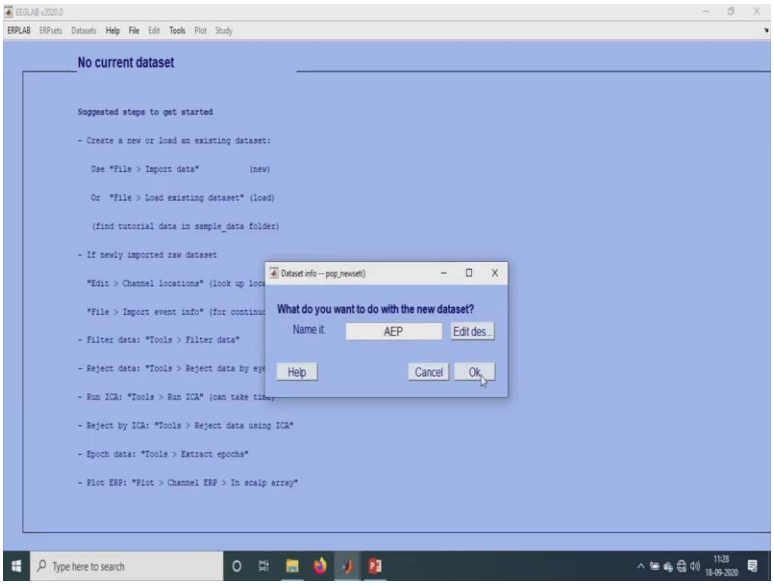



EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
Import data
Import epoch info
Import event info
Export
Load existing dataset
Save current dataset(s)
Save current dataset as
Clear dataset(s)
Create study
Load existing study
Save current study
Save current study as
Clear study / Clear all
Preferences
History scripts
Manage EEGLAB extensions
Quit
- Filter data: "Tools > Filter data"
- Reject data: "Tools > Reject data by eye"
- Run ICA: "Tools > Run ICA" (can take time)
- Reject by ICA: "Tools > Reject data using ICA"
- Epoch data: "Tools > Extract epochs"
- Plot ERP: "Plot > Channel ERP > In scalp array"
Type here to search
11:27
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
Import data
Import epoch info
Import event info
Export
Load existing dataset
Save current dataset(s)
Save current dataset as
Clear dataset(s)
Create study
Load existing study
Save current study
Save current study as
Clear study / Clear all
Preferences
History scripts
Manage EEGLAB extensions
Quit
Using EEGLAB functions and plugins
Using the FILE-IO interface
Using the BIOSIG interface
Troubleshooting data formats...
(for more use menu File > Manage EEGLAB extensions)
From ASCII/float file or Matlab array
From Biosemi BDF file (BIOSIG toolbox)
From EDF/EDF+/GDF files (BIOSIG toolbox)
From Neuroelectrics .EASY
From Neuroelectrics .NEDF
From Neuroscan .CNT file
From Neuroscan .EEG file
Import Philips .mff file
From Brain Vis. Rec. .vhdr file
From Brain Vis. Anal. Matlab file
- Filter data: "Tools > Filter data"
- Reject data: "Tools > Reject data by eye"
- Run ICA: "Tools > Run ICA" (can take time)
- Reject by ICA: "Tools > Reject data using ICA"
- Epoch data: "Tools > Extract epochs"
- Plot ERP: "Plot > Channel ERP > In scalp array"
Type here to search
11:28
18-09-2020


Choose a CNT file -- pop_loadcnt()
Desktop › Demo › EEG Data
Search EEG Data
Organize
New folder
Desktop
Downloads
Documents
Pictures
Ashwini
14_09_2020
Demo
EEG Data
NPTEL
OneDrive
This PC
Name
Date modified
Type
AEP.cnt
P300.cnt
VEP.cnt
29-02-2020 09:35
29-02-2020 09:35
29-02-2020 09:36
CNT File
File name:
(*.CNT, *.cnt)
Open
Cancel
- Run ICA: "Tools > Run ICA" (can take time)
- Reject by ICA: "Tools > Reject data using ICA"
- Epoch data: "Tools > Extract epochs"
- Plot ERP: "Plot > Channel ERP > In scalp array"
Type here to search
11:28
18-09-2020


ERPLAB
ERPsets
Datasets
Help
File
Edit
Tools
Plot
Study
No current dataset
Suggested steps to get started
- Create a new or load an existing dataset:
Use "File > Import data" (new)
Load a CNT dataset
Data format 16 or 32 bit (Default = Autodetect)
16-bits
32-bits
Autodetect
Time interval in s (i.e. [0 100]):
Check to Import keystrokes:
loadcnt() 'key', 'val' params
Large files, enter a file name for memory mapping (xxx.fdt)
Note: requires to enable memory mapping in EEGLAB memory options and only works for 32-bit files
Help
Cancel
Ok
- Reject by ICA: "Tools > Reject data using ICA"
- Epoch data: "Tools > Extract epochs"
- Plot ERP: "Plot > Channel ERP > In scalp array"
Type here to search
11:28
18-09-2020



Then there are as I said, there are various plugins that are there for this particular software. They are like we can have various importing functions, for importing the different types of EG files. So, here in this files we can have this EG extensions, manage EG extensions. So, in that, we can have various options like we can give the different plugins, we can download and we can keep it inside our plugin folder of EEGLAB. So, for now, we wanted the neuro scans systems EG, import format, so that has been given over here.

So, here we can just directly import the CNT file using this GUI. So, we just click that, and we can have the, so I take my AEP data in this. So, this is a cnt file, it is a continuous data file that has been obtained from the neuro scan system. So, we can just directly open it. If you open it will ask like, which is the number of bit you want and everything.

So, you just go with all the default parameters that has been given. So, it will give an auto detect itself, so we can name it however you want. So, we can I just, write it as AEP and then, so if you have a different name, many subjects you have or you have a different some any IDs or something like that, you can just paste in that manner itself.

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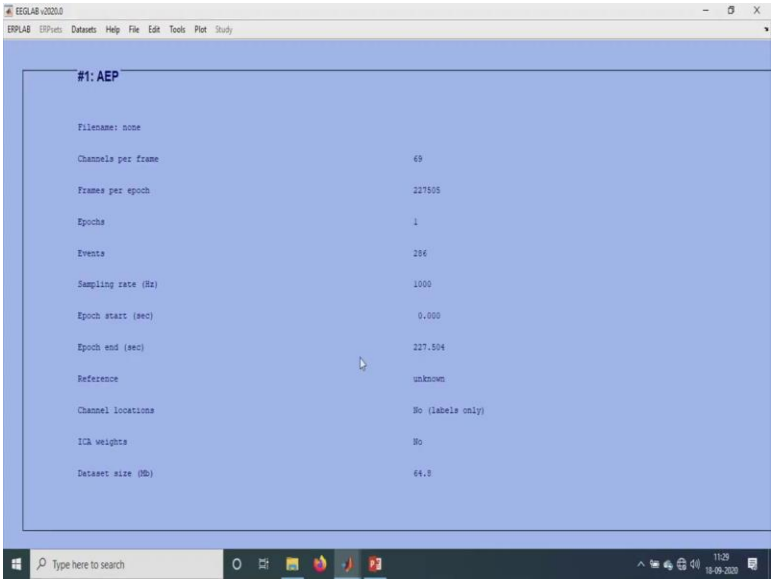
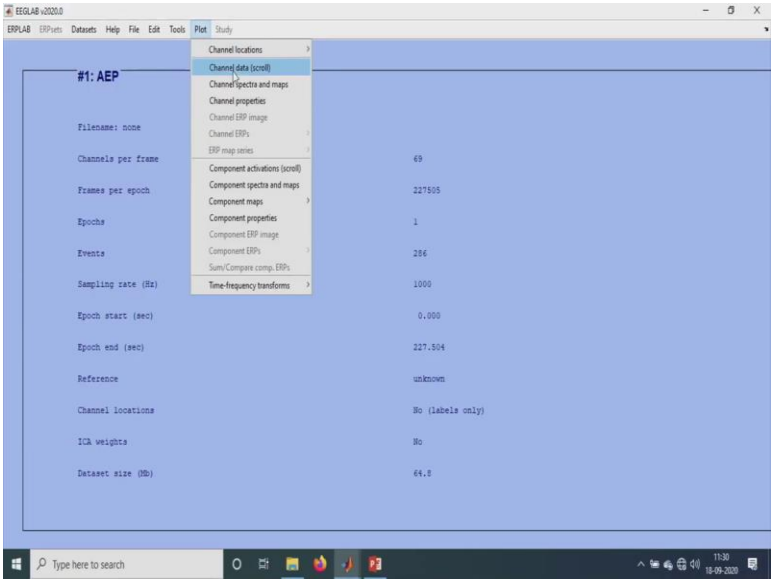


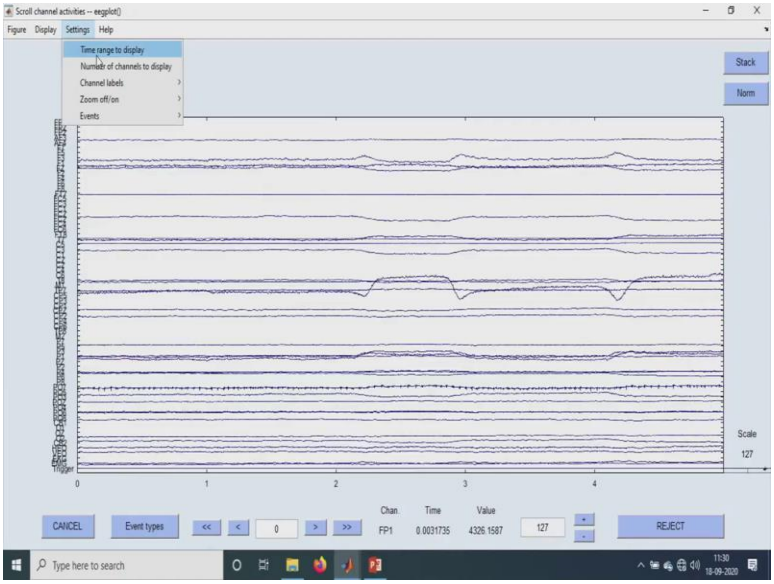
So, you will get the data set in this. We will, now we have imported the data inside this EEGLAB. So, over here we can see that the epochs are just one because we have not divided our EG into epochs, we have just the whole EG bunch of data that has been there. So, here are the events are, these are the number of events that is there. Events are nothing but the triggers that we have given. Like for example, now in the case of AEP we have the audio triggers that has been given. So, we can visualize those triggers also, I will just show you that later.

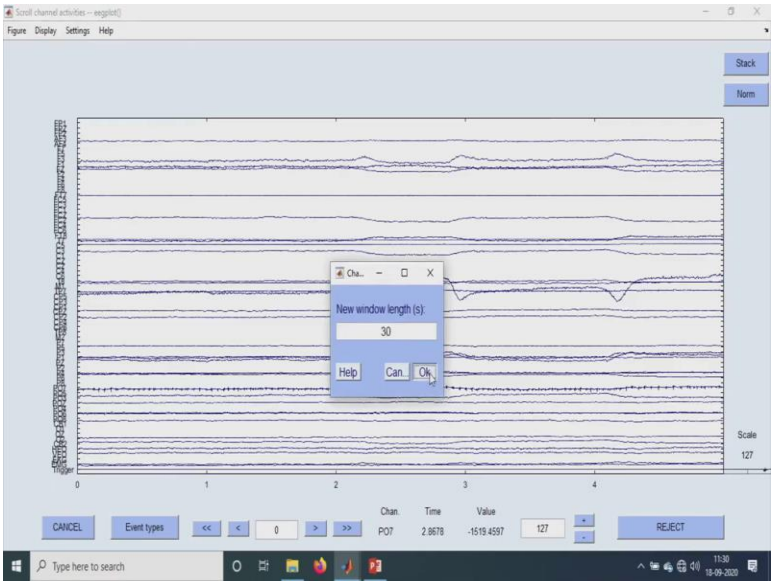
So, here we have the start and the end time, like first it starts, it starts from 0 to 27 seconds. So here this, this is a total time length of the experiment we have conducted and then the data size everything. So, we have, we can give this, externally we can give the channel locations or sometimes here the EEGLAB itself will have all these channel locations there inside the file itself.

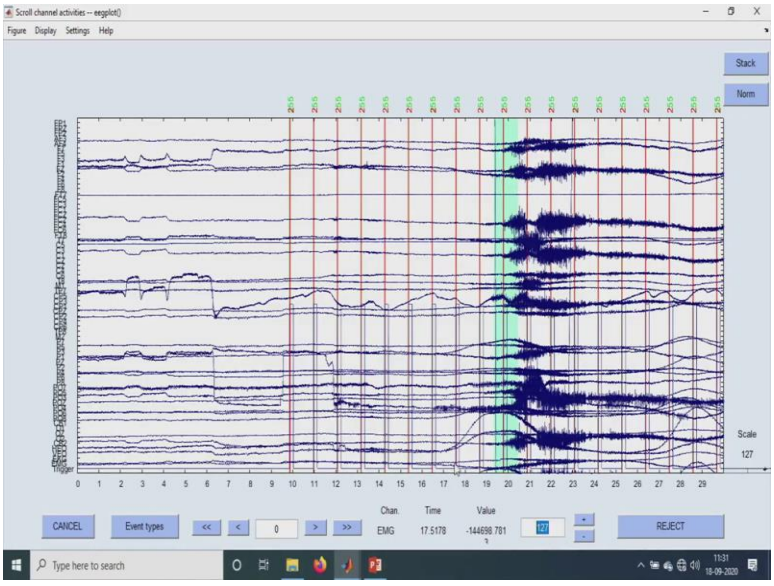
For example, in, Enobio systems or Open BCI systems and all we can give, we have to manually do all the, importing the data or the events based on the channel size, channel number, etc. or the columns number, like that. So, I will just go with this cnt file for now. So, next I will just show you how the plots look like.

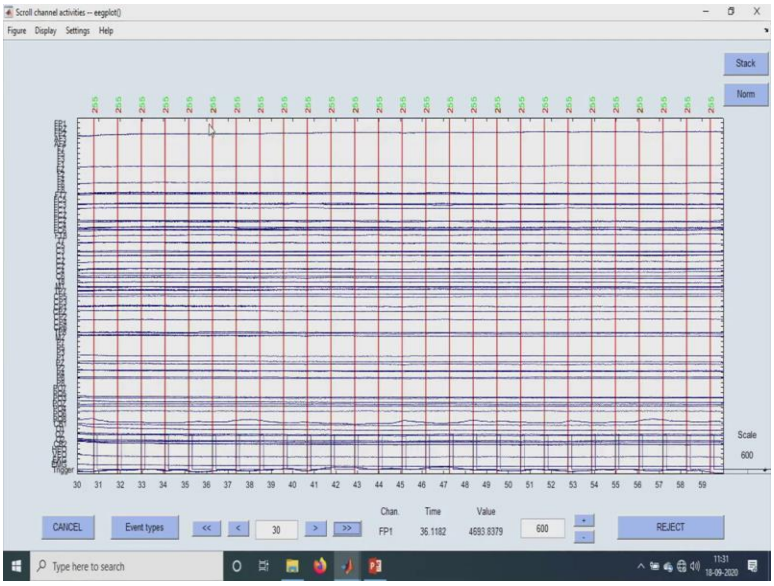
(Refer Slide Time: 05:19)

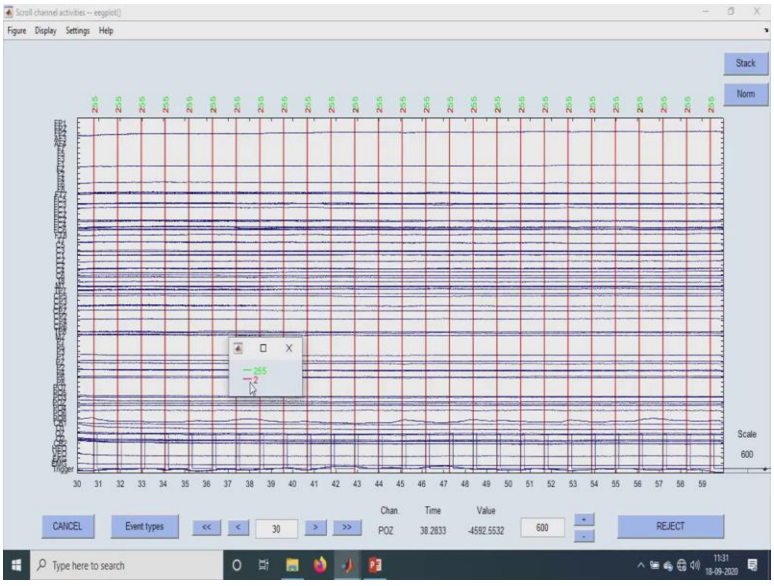





Scroll channel activities -- eegplot()
Figure Display Settings Help
Stack
Norm
Cha...
New window length (s):
30
Help
Can.
Ok
Scale
127
CANCEL
Event types
<<
<
0
>
>>
Chan.
Time
Value
PO7
2.8678
-1519.4597
127
REJECT
Type here to search
11:30
18-09-2020


Scroll channel activities -- eegplot()
Figure Display Settings Help
Stack
Norm
Scale
127
CANCEL
Event types
<<
<
0
>
>>
Chan.
Time
Value
EMG
17.5178
-144698.781
127
REJECT
Type here to search
11:31
18-09-2020



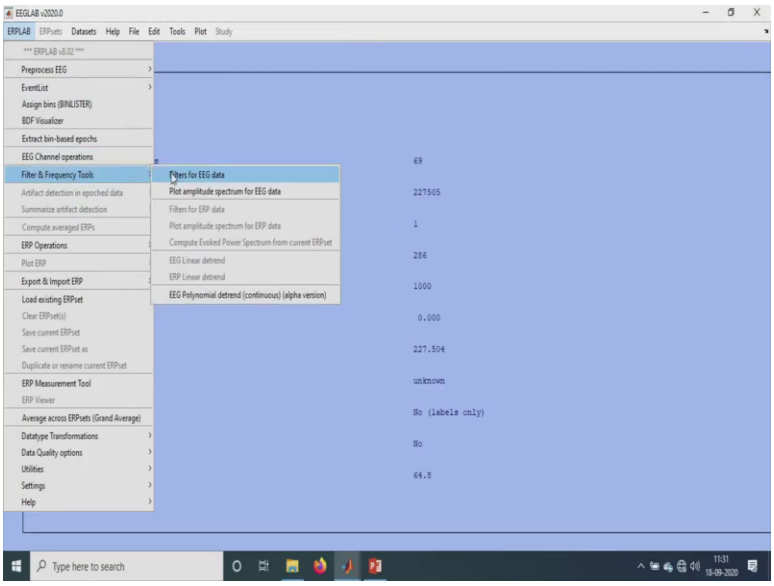


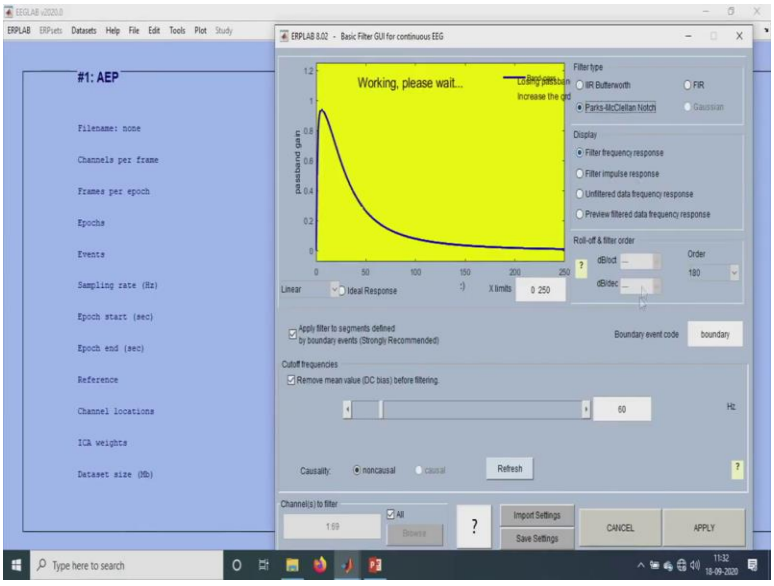
So, here in this plot session, we have the channel scroll data in this set, in this place, we can see how the different that these are the 64 channels that are being recorded and then it is, we can change the access like this is for 5 seconds like that. So, we can make the, make such a manner that we want 30 seconds per to be seen. So, here if you see, here we have all the triggers, these are the triggers this, these red lines that is there, those are the triggers and see here, we can have a lot of artifacts and all can be seen. So, we can manually also reject all this by just selecting like that, or else we can just do it using the EEGLAB analysis like the artifact rejection protocols.

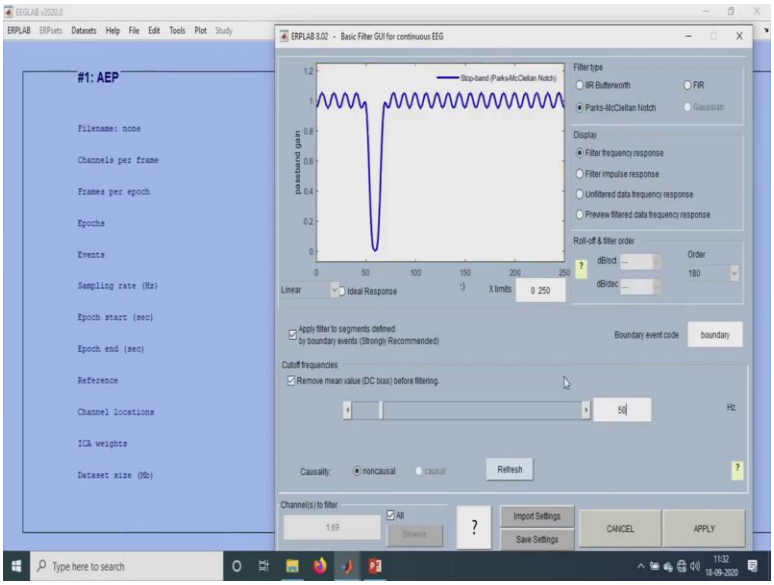
Here we can change the amplitude or like we can make it, however, smaller, bigger you want and here we can scroll the data from left to right like we can just move about us and see how the data

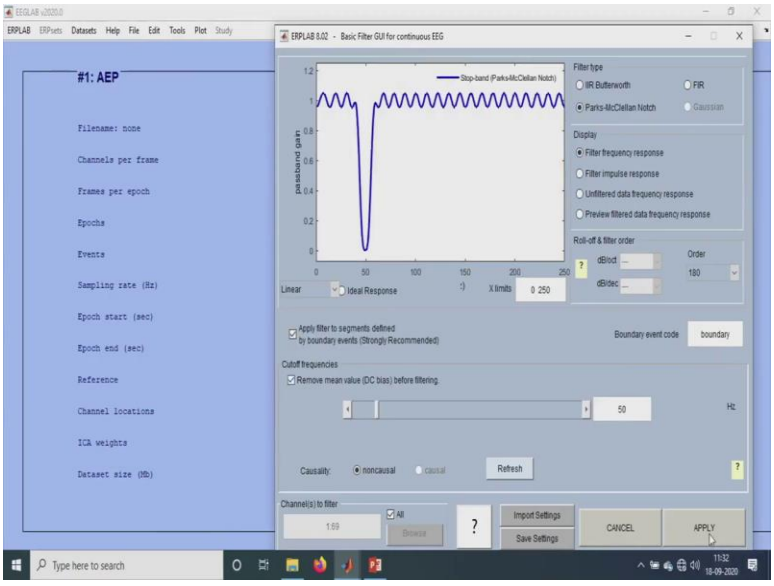
looks. So, this is just to see and you have to think, you have to check, what you have to check mainly is the, which, what is the trigger number over here. So, there are two, here there is, this 2 is our trigger like the AEP triggers this the 2 is our number, the trigger number that we have recorded over here.

(Refer Slide Time: 06:40)



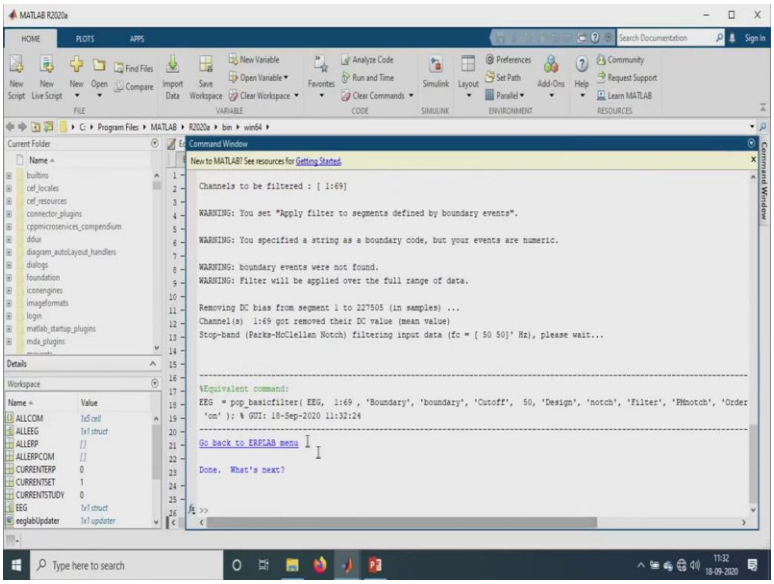


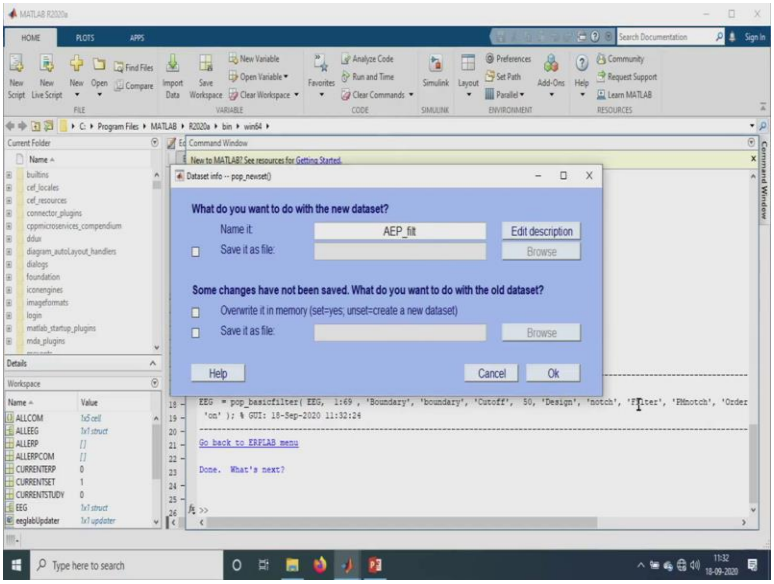




So, the next step is like the initial preprocessing. Before doing any analysis, we just wanted filter to be done, just a small filter called as the notch filter, we will just, there are various filters like the FIR filter or IIR filters. We will take this notch filter over here and usually for us we will take a 50 hertz of a notch filter and then just apply it.

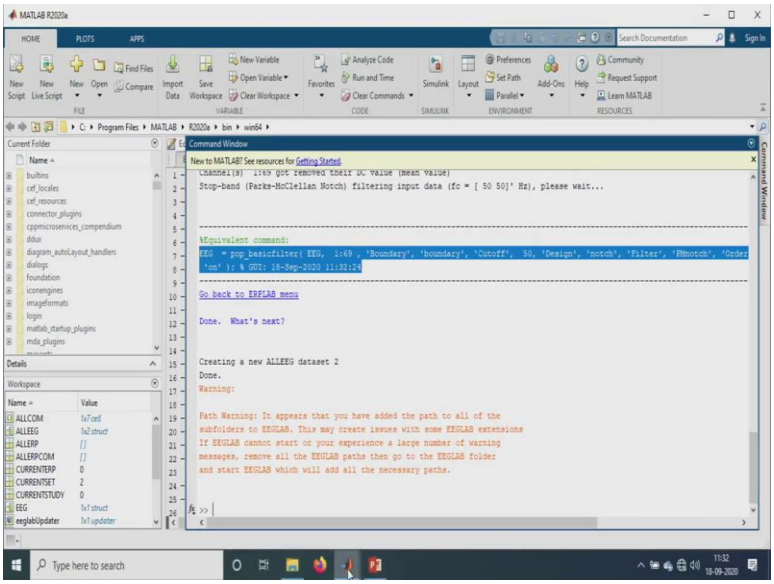
(Refer Slide Time: 07:12)

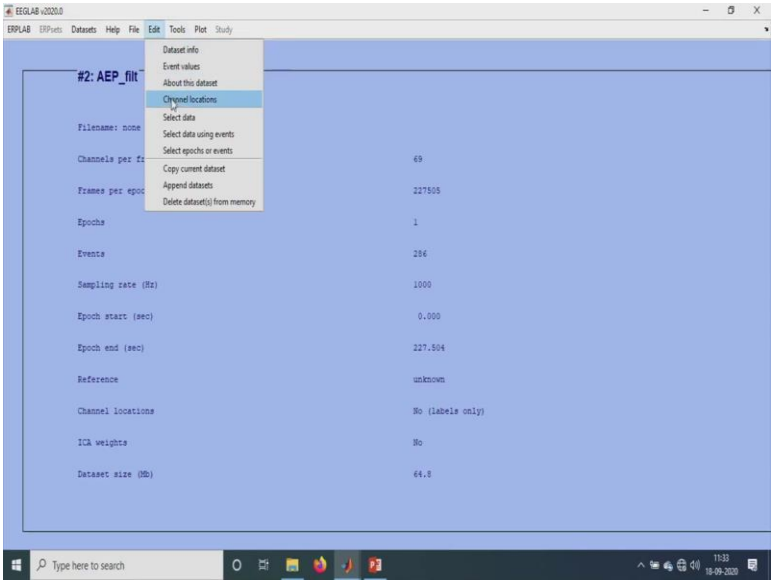


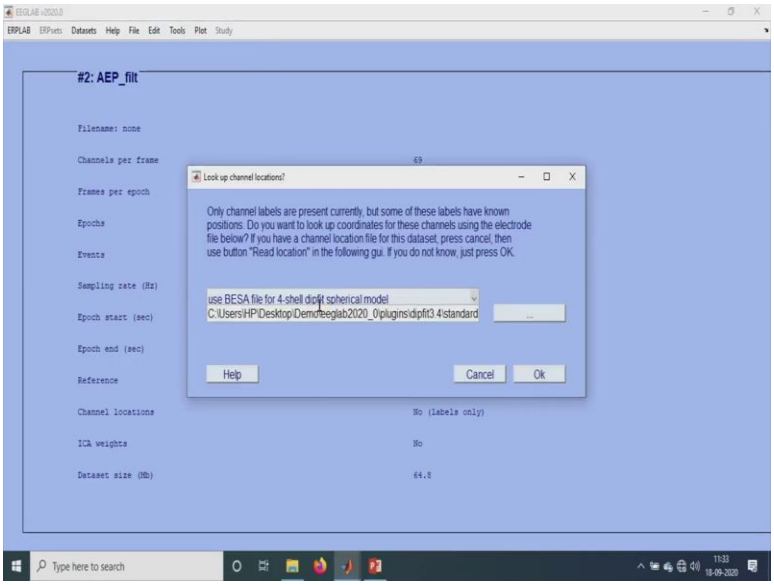


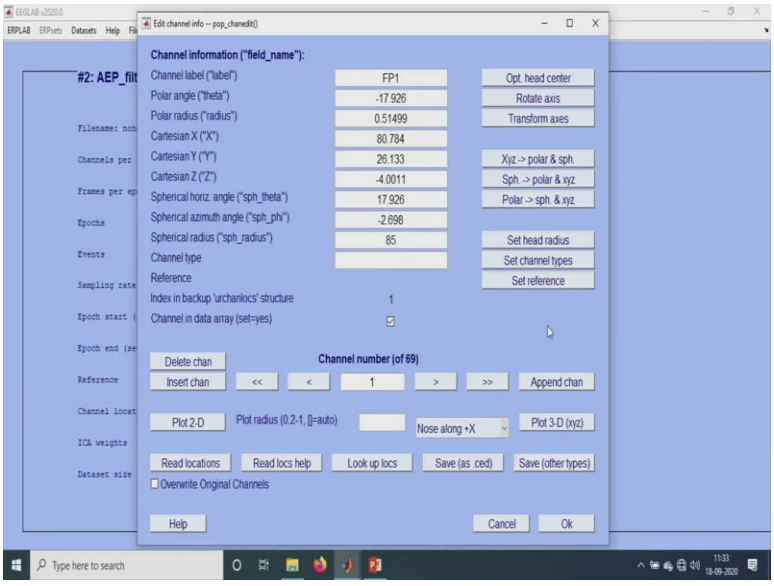
So here, while doing itself there will be, in this command window there will be how the processing has been done, how far it has been done, it is all shown and these are the equivalent commands that we get and this is the, itself gives what the data name you have to be, data set name you want it, it will only give or you can change according to your wish.

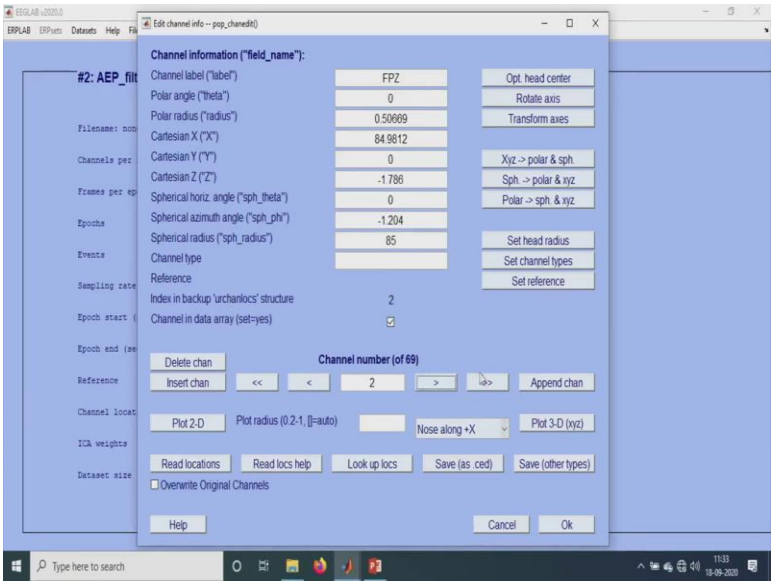
(Refer Slide Time: 07:31)

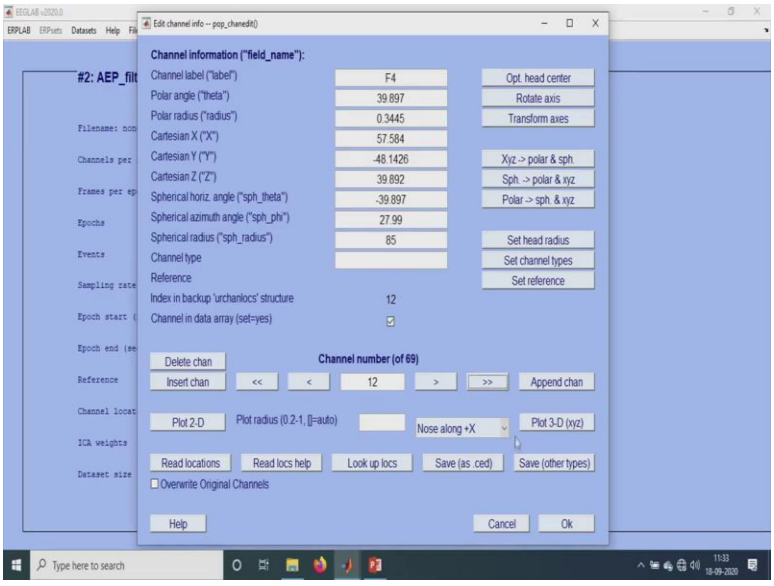





EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#2: AEP_filt
Filename: none
Channels per frame 69
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations No (Labels only)
ICA weights No
Dataset size (Mb) 64.8
Look up channel locations?
Only channel labels are present currently, but some of these labels have known positions. Do you want to look up coordinates for these channels using the electrode file below? If you have a channel location file for this dataset, press cancel, then use button "Read location" in the following gui. If you do not know, just press OK.
use BESA file for 4-shell dipfit spherical model
C:\Users\HP\Desktop\Demo\eeglab2020_0\plugins\dipfit3.4\standard
...
Help
Cancel
Ok
Type here to search
11:33
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help
#2: AEP_filt
Edit channel info -- pop_chanedit()
Channel information ("field_name"):
Channel label ("label") FP1
Polar angle ("theta") -17.926
Polar radius ("radius") 0.51499
Cartesian X ("X") 80.784
Cartesian Y ("Y") 26.133
Cartesian Z ("Z") -4.0011
Spherical horiz. angle ("sph_theta") 17.926
Spherical azimuth angle ("sph_phi") -2.698
Spherical radius ("sph_radius") 85
Channel type
Reference
Index in backup 'urchanlocs' structure 1
Channel in data array (set=yes)
Opt. head center
Rotate axis
Transform axes
Xyz -> polar & sph.
Sph. -> polar & xyz
Polar -> sph. & xyz
Set head radius
Set channel types
Set reference
Delete chan
Insert chan
Channel number (of 69)
<< < 1 > >>
Append chan
Plot 2-D
Plot radius (0.2-1, []=auto)
Nose along +X
Plot 3-D (xyz)
Read locations
Read locs help
Look up locs
Save (as .ced)
Save (other types)
Overwrite Original Channels
Help
Cancel
Ok
Type here to search
11:33
18-09-2020



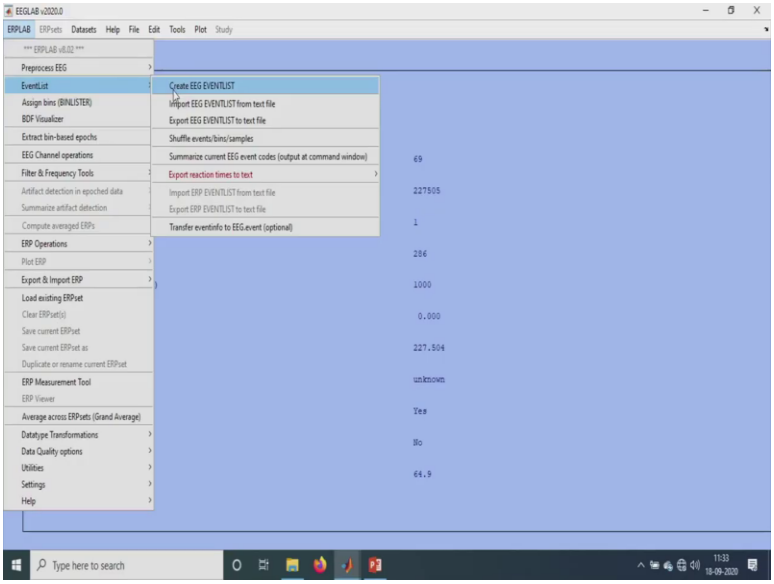


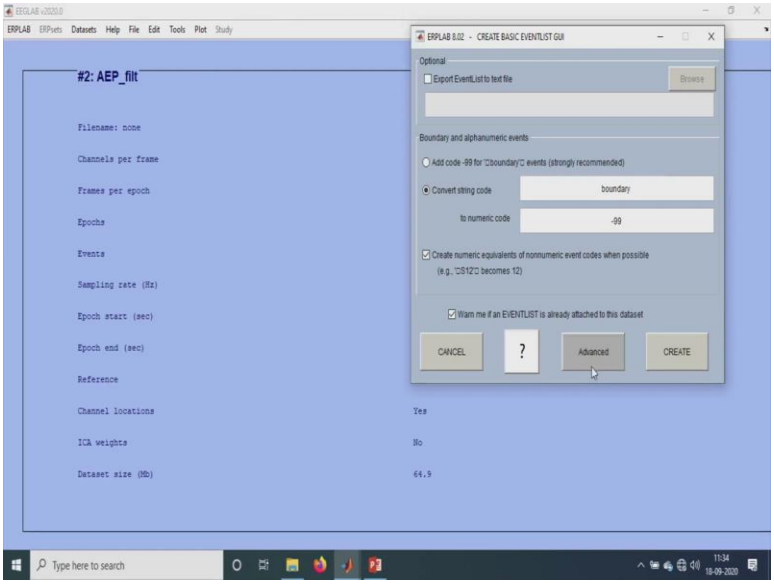
So, here are these are the equivalent, this is the equivalent command window. So, we will after doing all these steps, we can just copy all these and put them into our scripts, we can make the scripts based on that. So, I will just work with this GUI for now. So here, we can give this channel locations, so for that we just go to this edit, and here we have the channel location. In this channel location, it is all the default, it is all like the 64 channel data it is like all the default that has been present. So, we can just go with it.

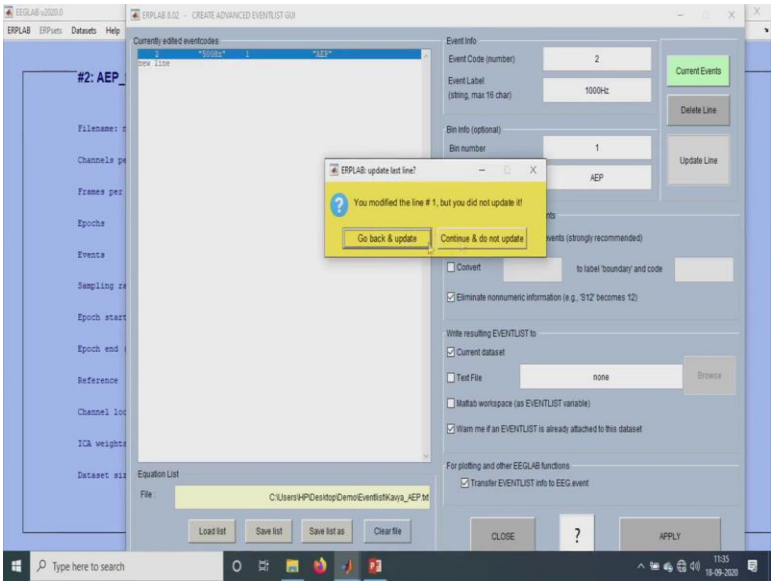
And then, here we have the different electrodes and its positions and everything, it has been given and for that, for 64, 69 channels how it looks and everything is we can just look about and

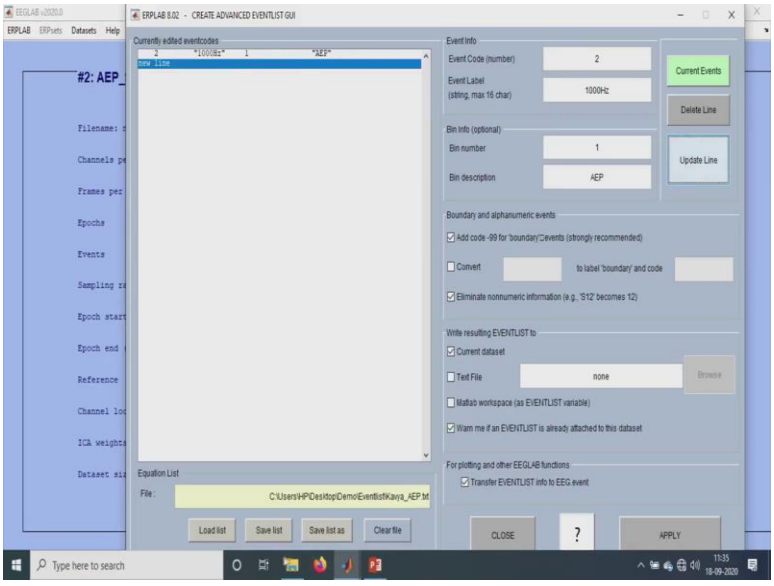
then this is all the default just put in. So it will get, the channel locations will be fid. So here we have all the channel locations done.

(Refer Slide Time: 08:32)









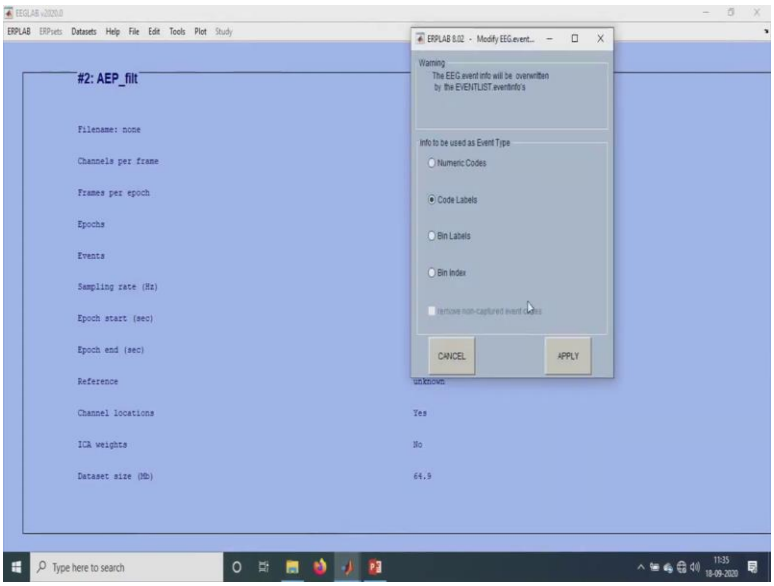
Now next we have to do is the event list. So, what is this event list. Now, the system this MATLAB it does not know, like whether what is the, what is the event name, how does it, how should it look and all it does not know. So, for us we know that okay that, the triggers that are coming as 2 is our, they are the events for us, but then the system should be given, we have to give the input to that system, that okay this 2 is for triggers.

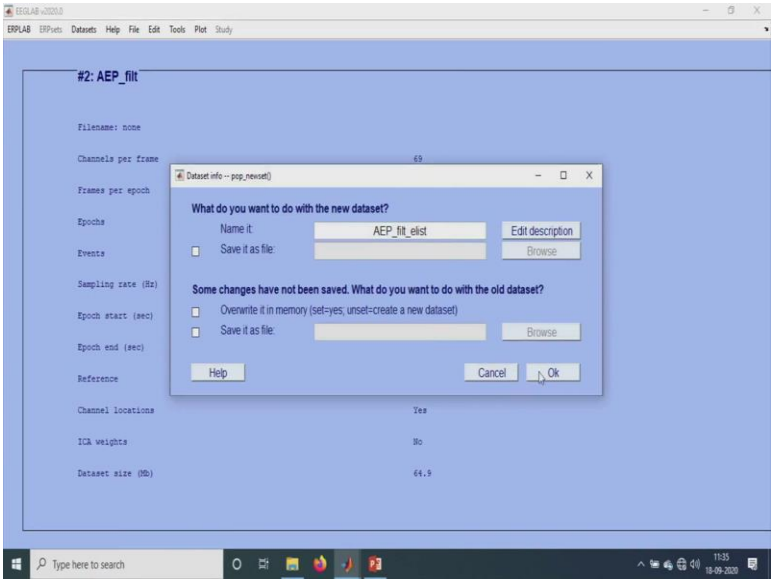
So, we just go to the advanced protocol. So here, we have to, this is the event name. So here, this, this two is the event name that we had given in that is there in the continuous data file and we just name it as, it will be 1000 hertz and then we assign a number called as this bin. Based on this bin number only we will be able to, we will be able to do the bin operations or we can, we

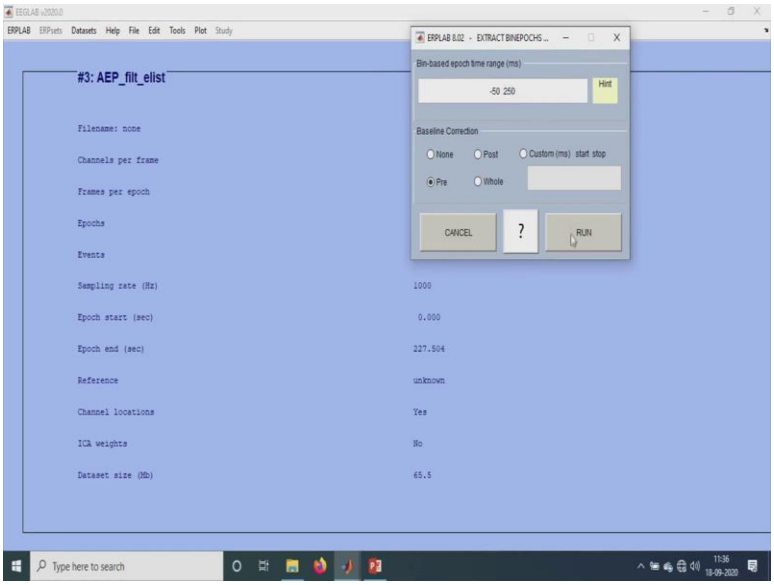
can visualize whatever waveforms or ERPs which we require based on this bin numbers and these inputs be given over here.

So, we just, and we just write accordingly. So, based on what, what triggers based on, like for AEP it is just 1 trigger, so we can just give one line like this. So, we can just update, update the line. So, this is how it gets updated and you can just save it also, later on you can use the same event less. So, just save it and then we can apply it.

(Refer Slide Time: 10:15)







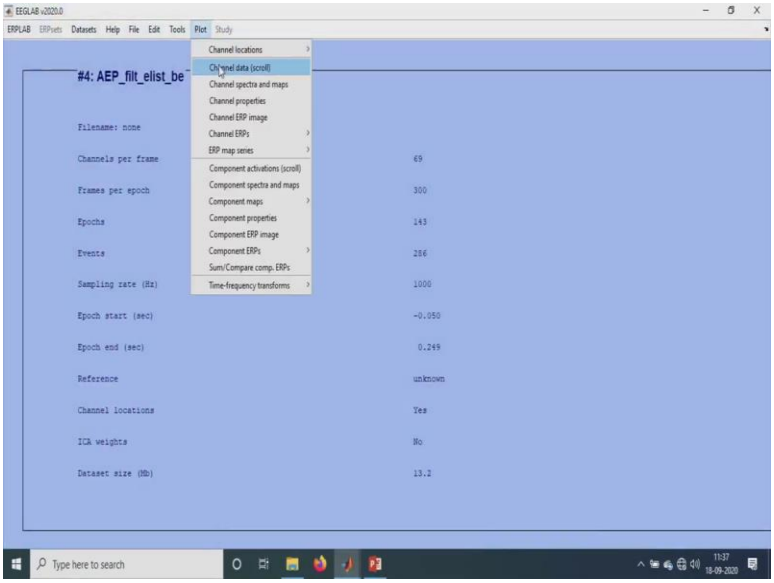
So, what happens is, all these then all the numbers which was named as 2, it will now become bin 1s or it will be named in that manner. So, that is how, that is why we are doing this particular step and we can just, this is called as the event list, creating the event list, this particular step is called as creating the event list. Now, next, what next what we have to do is the epoching. Now, as I told it is like from 0 to 257 seconds the whole data has been given.

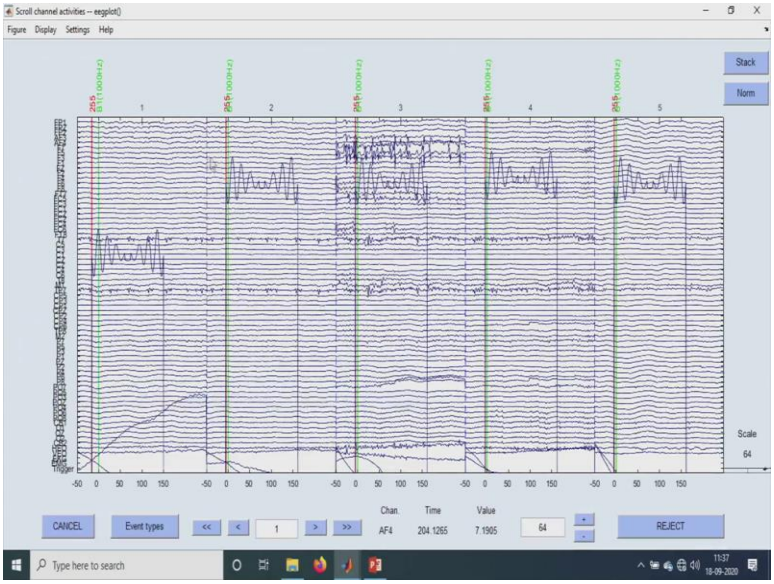
But I require for a particular trigger I want a pre, pre-stimulus I want some 50 microseconds, milliseconds and after that, I want some 200 milliseconds like that. So, we can just, we can just decide our time frame of how far we want all this and that is called an epoching.

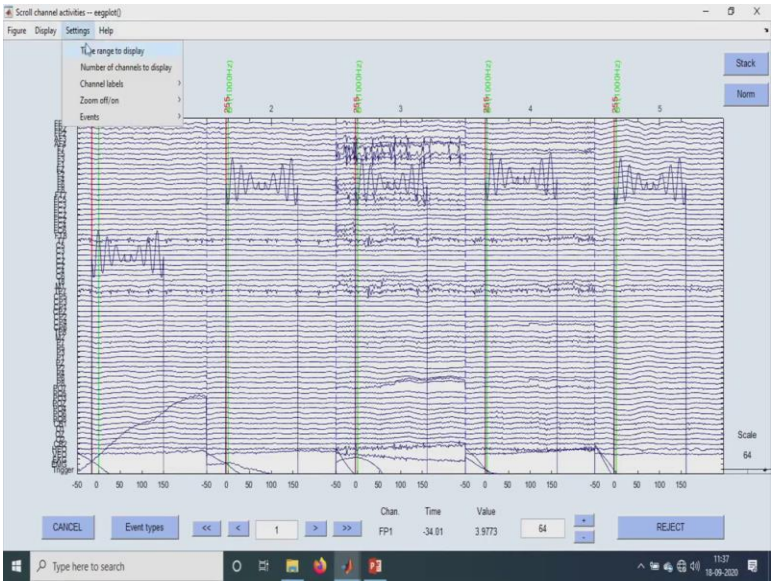
So, here we can create the epochs, we can extract the bin based epochs, so this is how it looks and then, so we always keep a pre baseline correction, because we wanted to know how the data looks before the trigger comes in so that we will get an idea of how it looks and how the base correction has been done and so, so we will take, for now in this AEP we just require from minus 50 to 200 milliseconds.

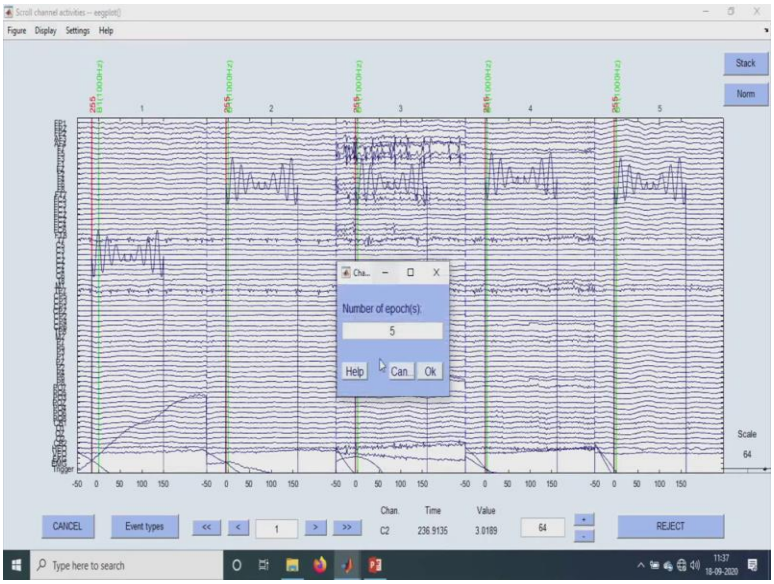
So, I just do it in this time frame or we can change it also if you want to 30, 300 or make it 250. So, like that, we can change however we want and then run it. So, it runs all the data, so it creates the event list. So, this is how it creates the event the extract the epochs. So, after epoching how does the data looks.

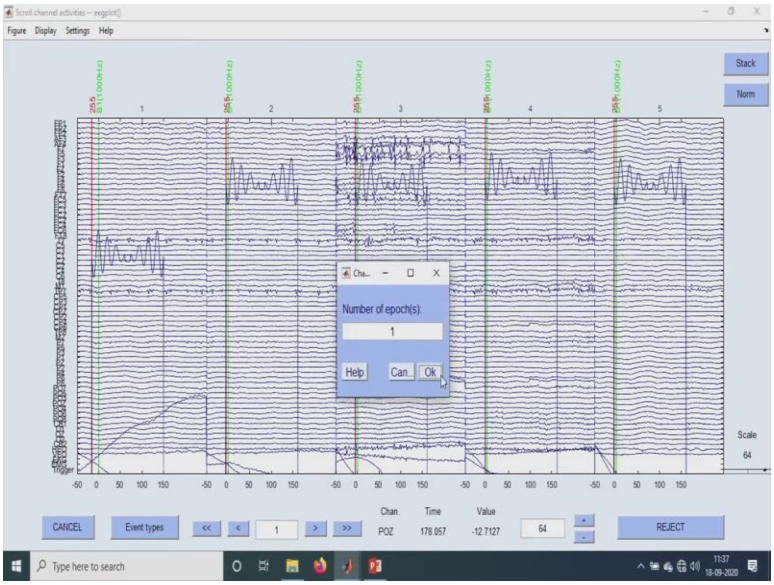
(Refer Slide Time: 12:07)





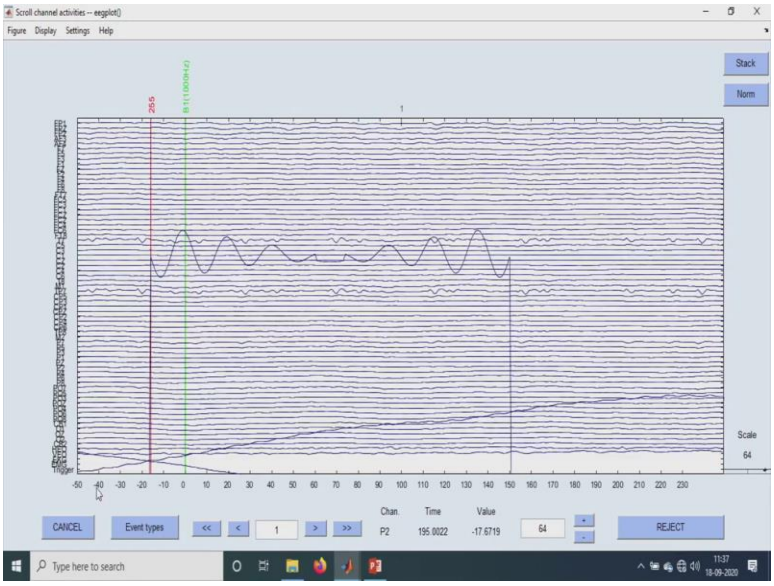

Scroll channel activities -- eegplot()
Figure Display Settings Help
Time range to display
Number of channels to display
Channel labels
Zoom off/on
Events
Stack
Norm
Scale
64
CANCEL
Event types
REJECT
Chan. Time Value
FP1 -34.01 3.9773
Type here to search

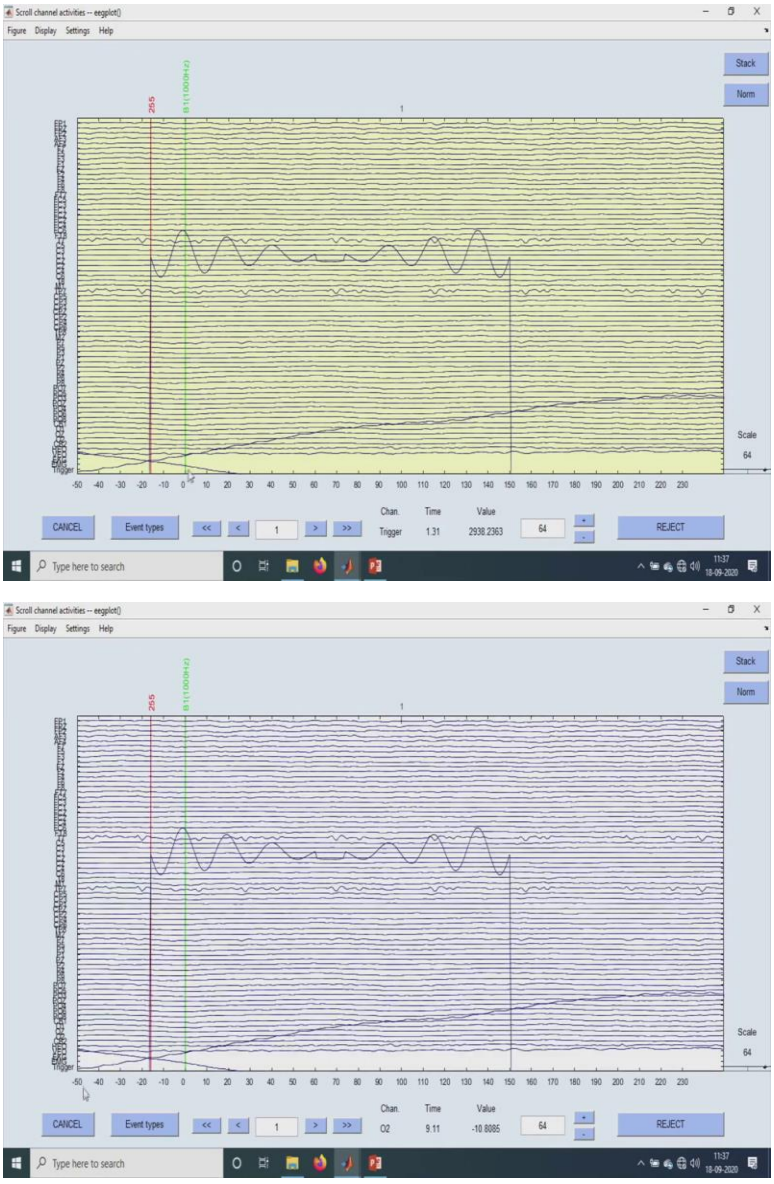

Scroll channel activities -- eegplot()
Figure Display Settings Help
Stack
Norm
Scale
64
Number of epoch(s):
5
Help
Can.
Ok
CANCEL
Event types
REJECT
Chan. Time Value
C2 236.9135 3.0189
Type here to search



So, if I just scroll this data now, this particular data set for this data set. So here we see, this, these are this, this is the bin values, these are the bins which, which was been assigned for this. So here, these are all the artifacts that would be recorded. So, what we will see is, I will just show you how does one epoch look, so I will just make, I will just show one epoch how does it look.

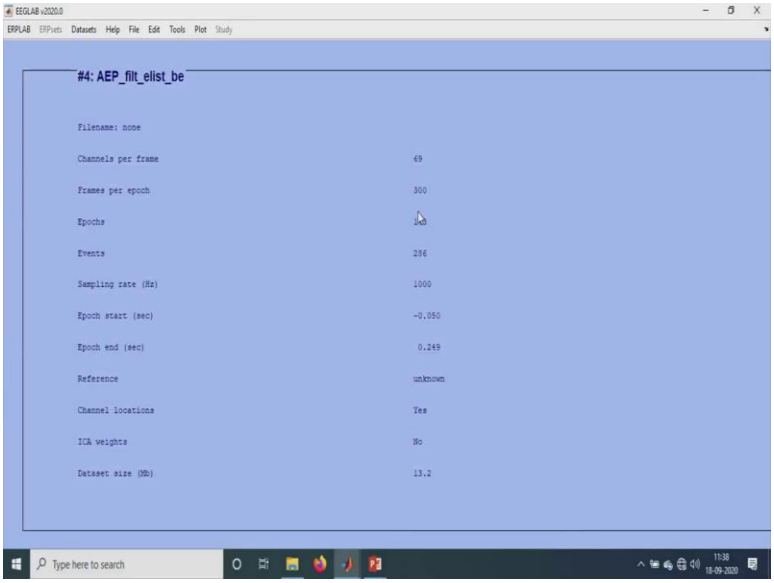
(Refer Slide Time: 12:30)





So here which we, if we see this is the trigger, from this trigger I want just, so it will, it will for all this, for all triggers, it will show like this, but then we want it from minus 50 to 250. So, I had just did that extracting the epochs. So, this is how it looks, this is how the one, just one epoch looks. So, similarly, there are nearly 120 events that will be there, so there will be 120 epochs that will be created in this manner.

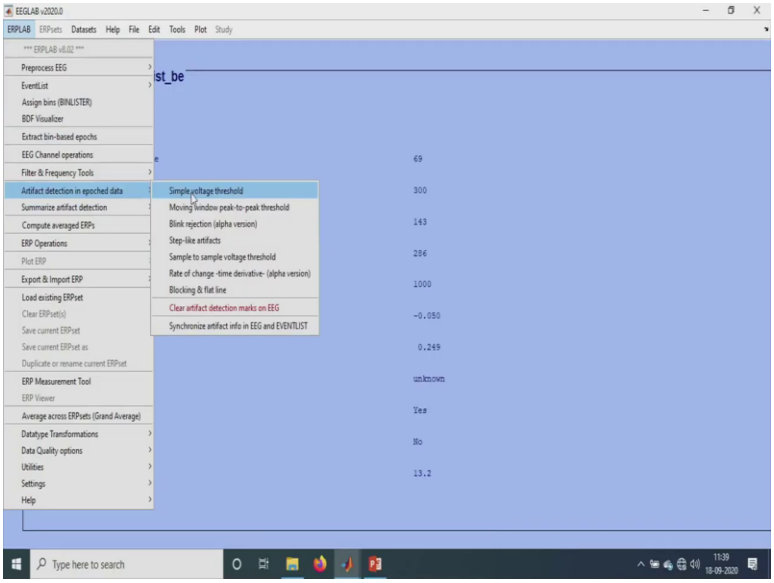
(Refer Slide Time: 13:04)

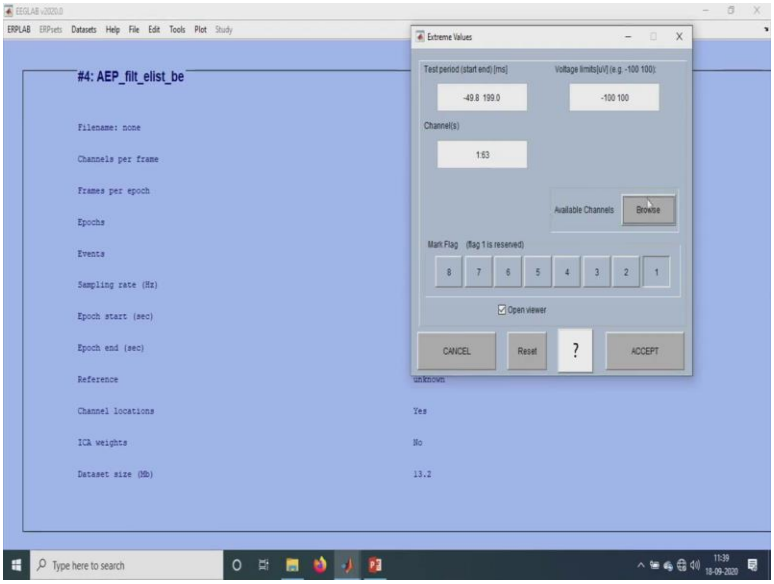


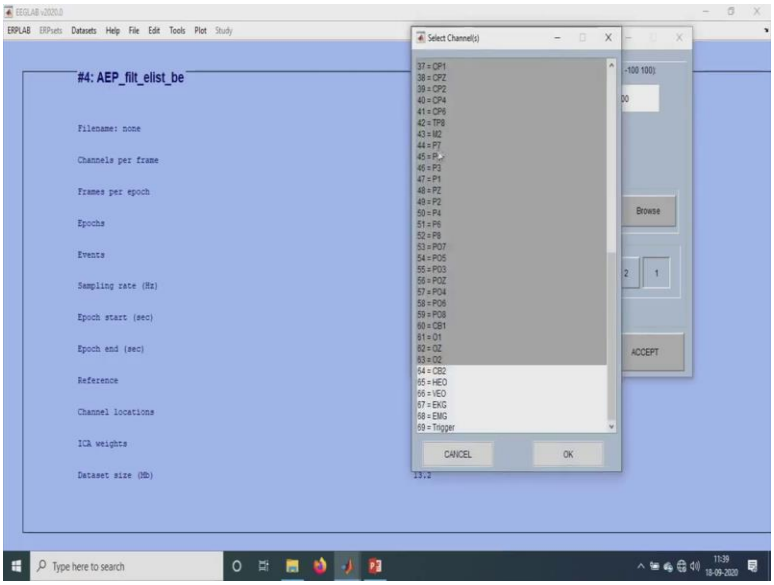
For this, further, if you do some artifact rejection and everything some of these epochs and all will be reduced, it will be, it will be removed due to the artifacts the present. So, those now all these ERPs and all its comes in so microvolts in that range it comes. So, just one epoch if you visualize, if you want to see how one epoch or one, how the waveform of one epoch looks it will be very, very less. So, for that reason only how many of our events are there, we average all together that and then obtain.

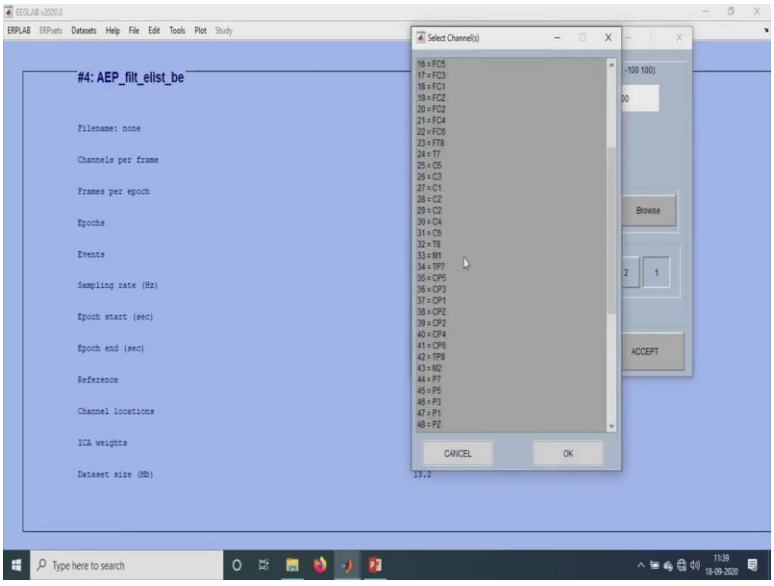
That is why we have any experiment if you do also, we do not do just for one trigger, for just one tone we do not do, we do for some money 120 triggers or 150 triggers or sometimes even 1000 triggers. So, it depends upon the experiment as such.

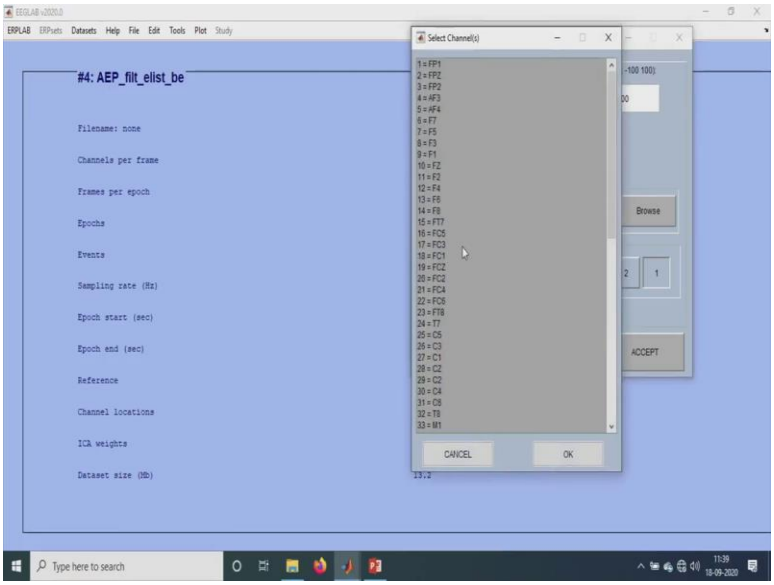
(Refer Slide Time: 13:55)

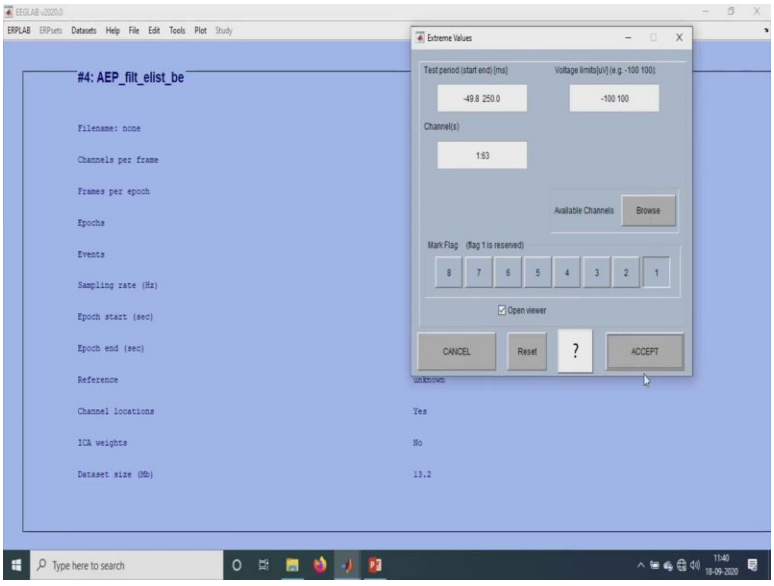





EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#4: AEP_filt_elist_be
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Select Channel(s)
37 = CP1
38 = CPZ
39 = CP2
40 = CP4
41 = CP6
42 = TP8
43 = M2
44 = P7
45 = P5
46 = P3
47 = P1
48 = PZ
49 = P2
50 = P4
51 = P6
52 = P8
53 = PO7
54 = PO5
55 = PO3
56 = POZ
57 = PO4
58 = PO6
59 = PO8
60 = CB1
61 = O1
62 = OZ
63 = O2
64 = CB2
65 = HEO
66 = VEO
67 = EKG
68 = EMG
69 = Trigger
CANCEL
OK
Browse
ACCEPT
Type here to search
11:39
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#4: AEP_filt_elist_be
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Select Channel(s)
16 = FC5
17 = FC3
18 = FC1
19 = FCZ
20 = FC2
21 = FC4
22 = FC6
23 = FT8
24 = T7
25 = C5
26 = C3
27 = C1
28 = CZ
29 = C2
30 = C4
31 = C6
32 = T8
33 = M1
34 = TP7
35 = CP5
36 = CP3
37 = CP1
38 = CPZ
39 = CP2
40 = CP4
41 = CP6
42 = TP8
43 = M2
44 = P7
45 = P5
46 = P3
47 = P1
48 = PZ
CANCEL
OK
Browse
ACCEPT
Type here to search
11:39
18-09-2020





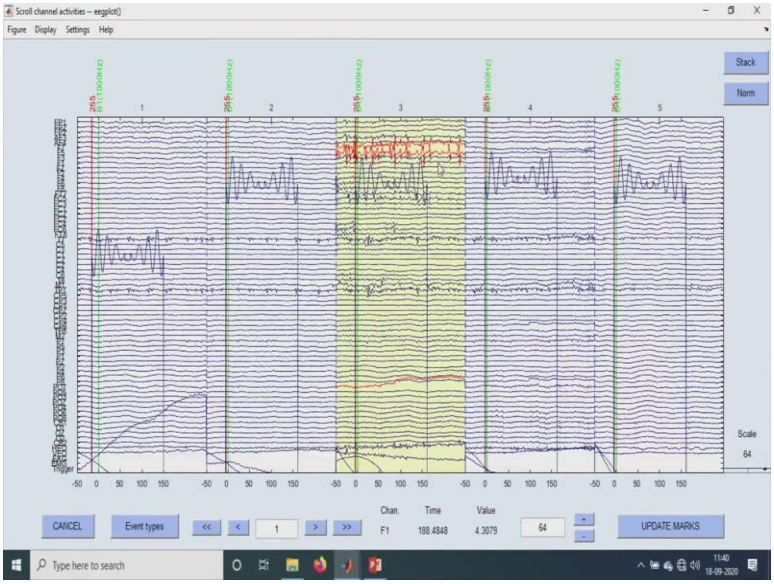
So, next, I will just do the artifact rejection. So, artifact detection first we will do is using this threshold voltage, threshold this is the most commonly used threshold artifact rejection method that they have used. Now, what we have to do is in this there are so many channels, in this, I want only these 64 channels alone to be crossing the certified rejection. The other channels if you take, it will result in all the events to be rejected.

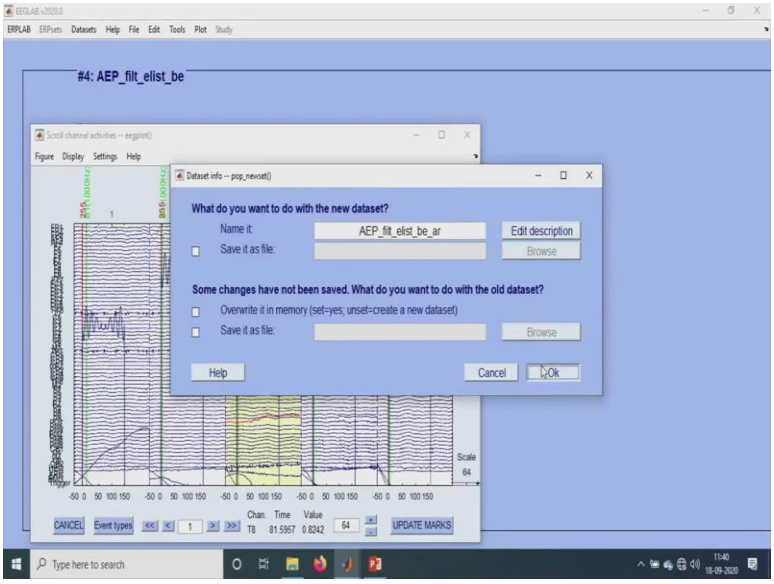
So, that is why I just take only till the 64, the trigger channels especially and this EMG, EKG channels and all you should not select for artifact rejection because it will, it will reject the whole data set like all whichever data we require it will all take off, I mean it will just reject of all

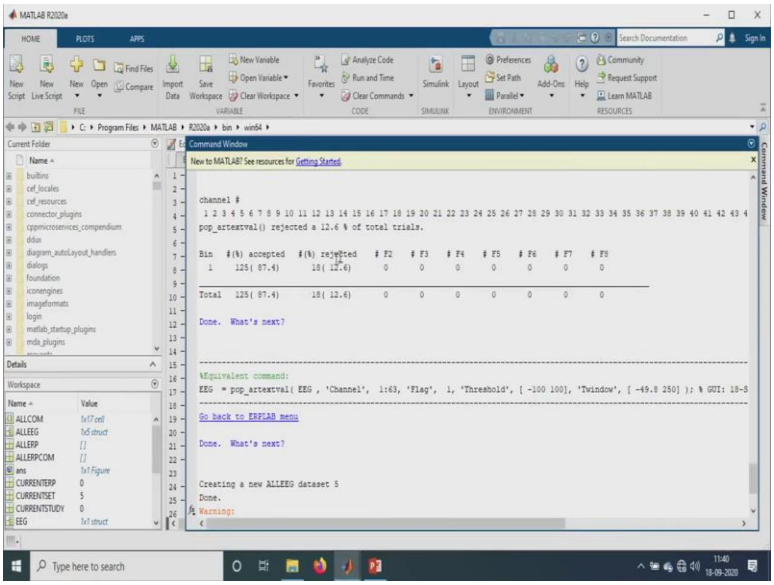
those. So, we just take only the first 64 channels and here we have the time period from 200, so it will be from 2, minus 52 to 250 second.

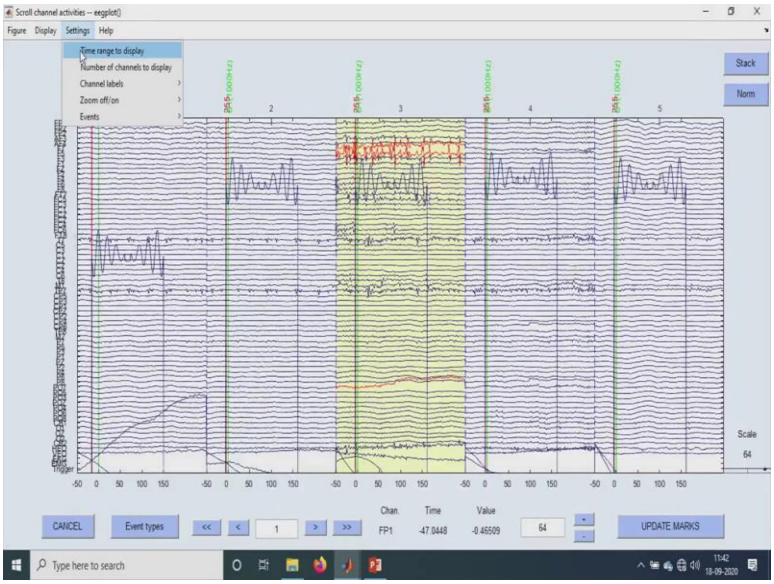
And then the voltage limits, as I told you always the artifact rejection it will take only from minus 50 minus, minus 100 to plus 100 microvolts. So, this is, this particular we can change accordingly to what you think the, not the voltage limit should be. So, mostly it will be minus 100 to 100 alone. Then we just, do the artifact rejection.

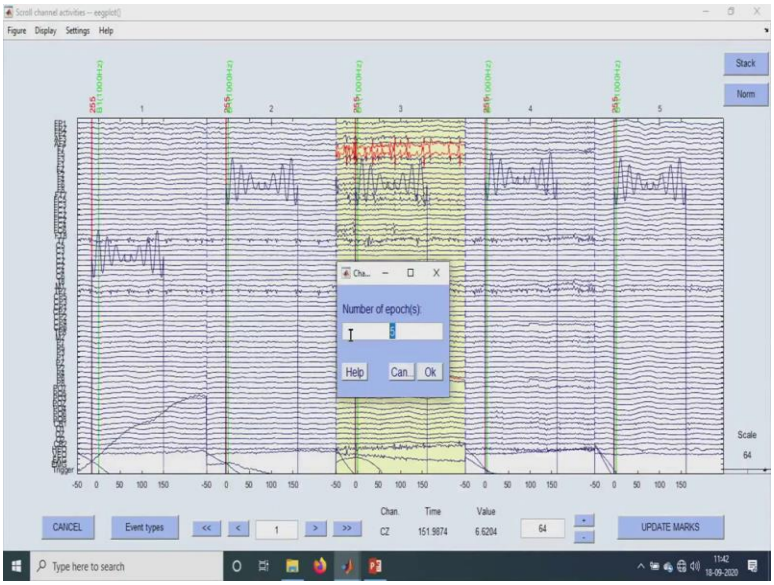
(Refer Slide Time: 15:28)

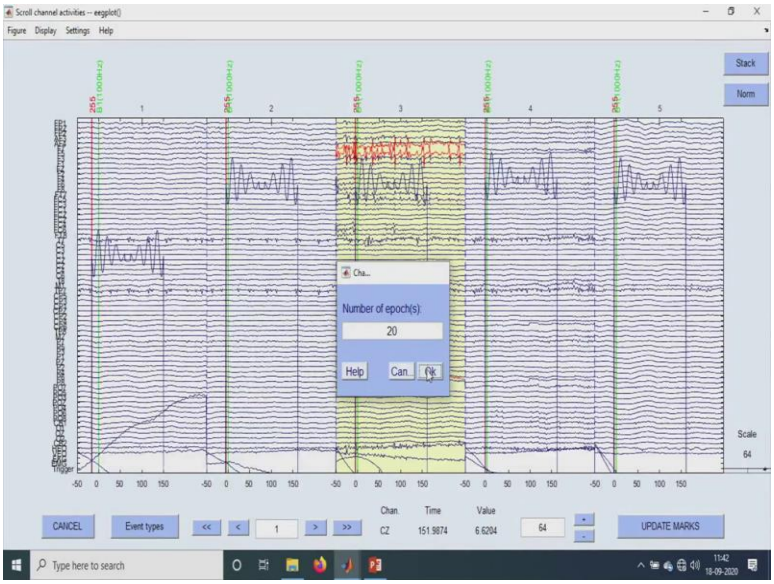


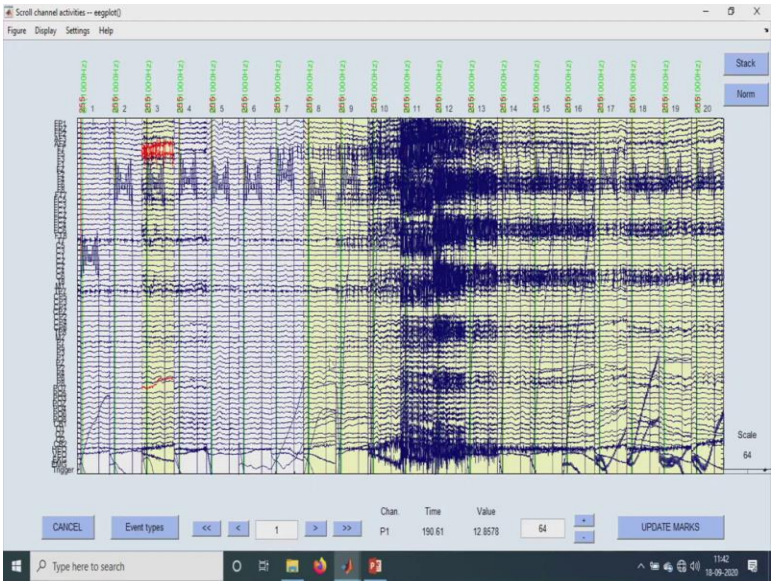


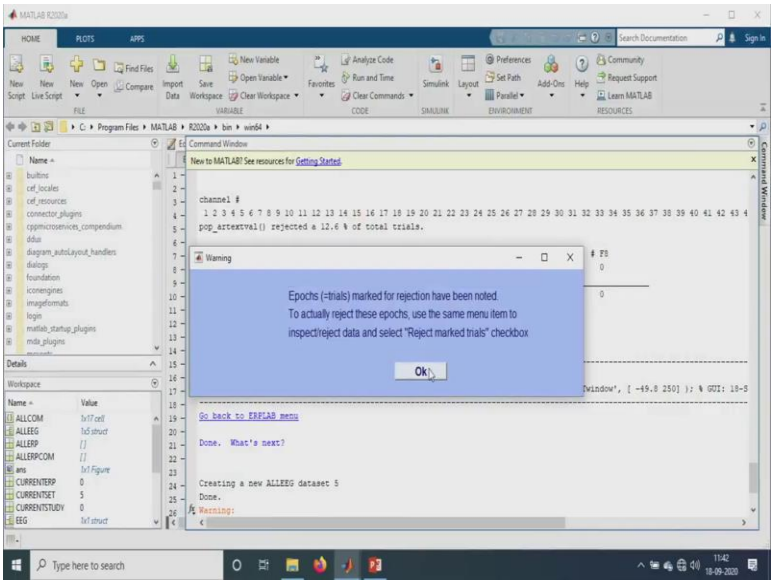

MATLAB R2020a
HOME
PLOTS
APPS
Command Window
channel #
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 4
pop_artextval() rejected a 12.6 % of total trials.
Bin #(k) accepted #(k) rejected # F2 # F3 # F4 # F5 # F6 # F7 # F8
1 125(87.4) 18(12.6) 0 0 0 0 0 0 0
Total 125(87.4) 18(12.6) 0 0 0 0 0 0 0
Done. What's next?
%Equivalent command:
EEG = pop_artextval(EEG , 'Channel', 1:63, 'Flag', 1, 'Threshold', [-100 100], 'Twindow', [-49.8 250]); % GUI: 18-S
Go back to ERPLAB menu
Done. What's next?
Creating a new ALLEEG dataset 5
Done.
Warning:
Type here to search

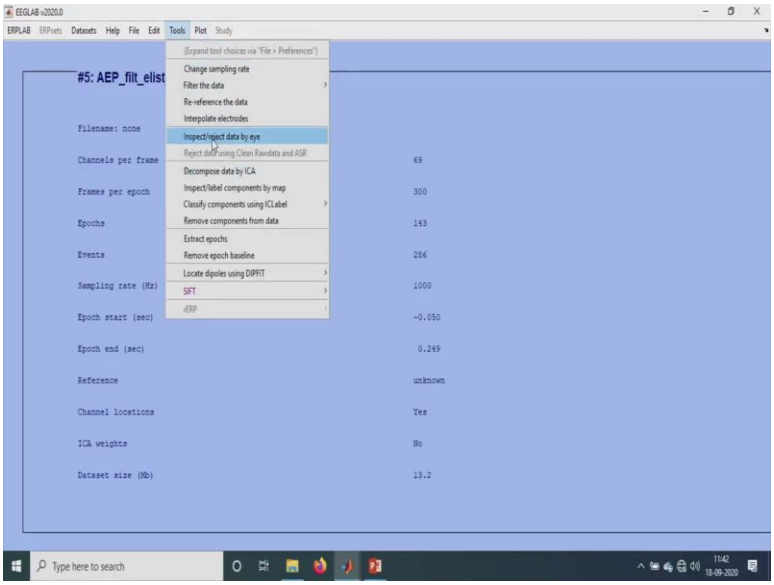

Scroll channel activities -- eegplot()
Figure Display Settings Help
Time range to display
Number of channels to display
Channel labels
Zoom off/on
Events
Stack
Norm
Scale
64
CANCEL
Event types
UPDATE MARKS
Chan. Time Value
FP1 -47.0448 -0.46509
Type here to search

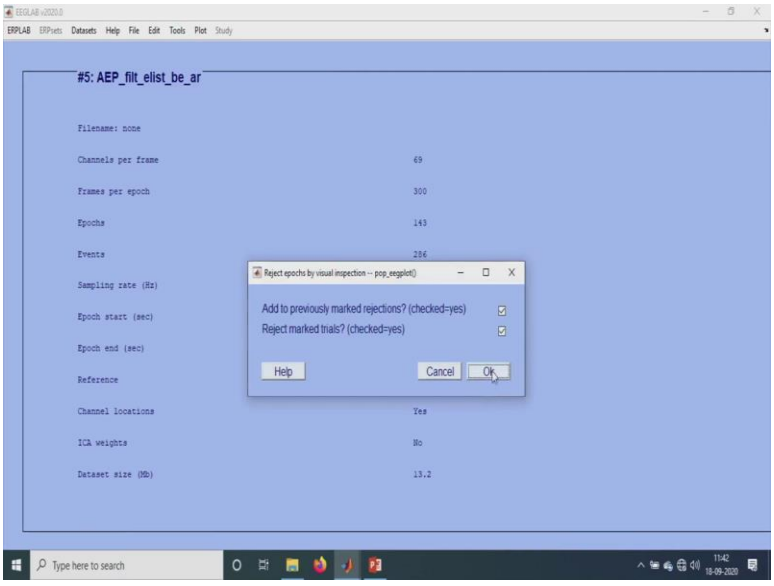

Scroll channel activities -- eegplot()
Figure Display Settings Help
Stack
Norm
Number of epoch(s):
Help
Can.
Ok
Scale
64
CANCEL
Event types
UPDATE MARKS
Chan.
Time
Value
CZ
151.9874
6.6204
Type here to search
11:42
18-09-2020

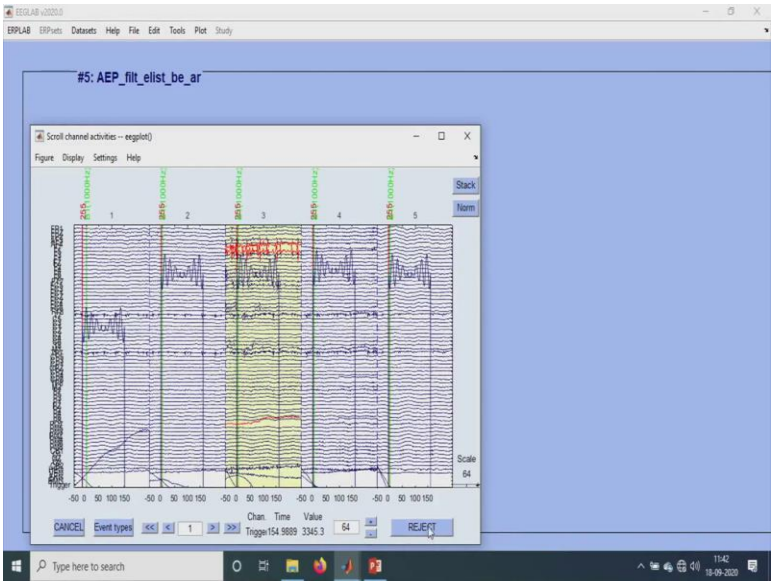

Scroll channel activities -- eegplot()
Figure Display Settings Help
Stack
Norm
Number of epoch(s):
20
Help
Can.
Ok
Scale
64
CANCEL
Event types
UPDATE MARKS
Chan.
Time
Value
CZ
151.9874
6.6204
Type here to search
11:42
18-09-2020

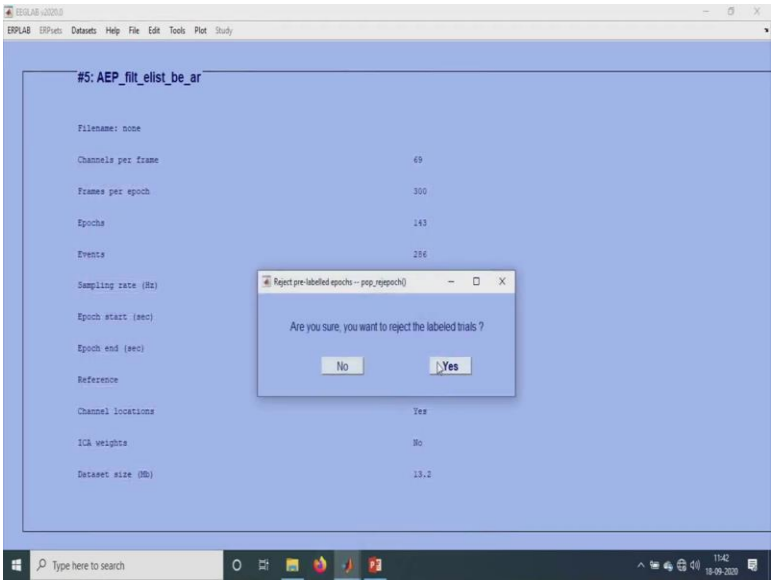

Scroll channel activities -- eegplot()
Figure Display Settings Help
Stack
Norm
Scale
64
CANCEL
Event types
Chan. Time Value
P1 190.61 12.8578
UPDATE MARKS
Type here to search

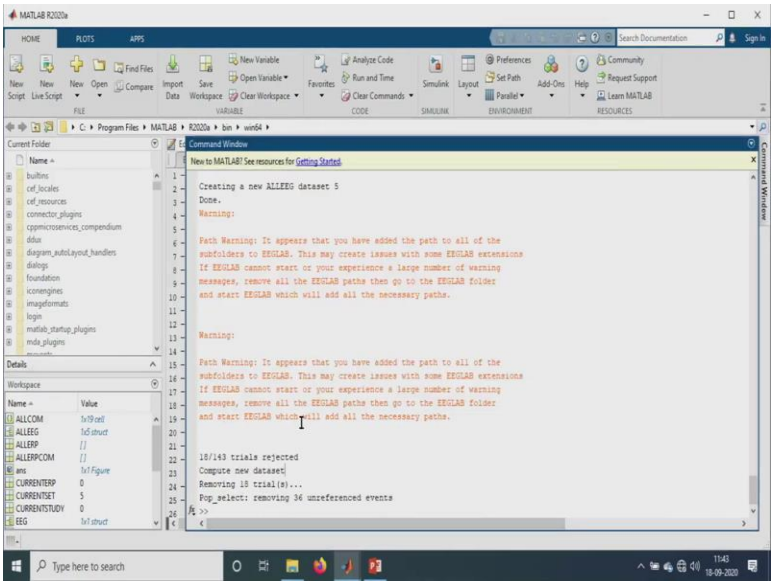

MATLAB R2020a
HOME PLOTS APPS
Command Window
channel #
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 4
pop_artextval() rejected a 12.6 % of total trials.
Warning
Epochs (=trials) marked for rejection have been noted.
To actually reject these epochs, use the same menu item to
inspect/reject data and select "Reject marked trials" checkbox
Ok
Go back to ERPLAB menu
Done. What's next?
Creating a new ALLEEG dataset 5
Done.
Warning:
Type here to search

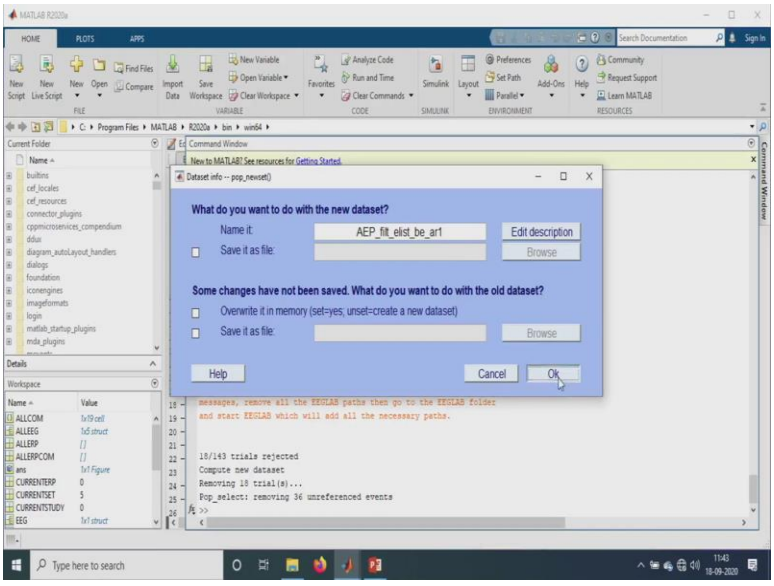

EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#5: AEP_filt_elist
(Expand tool choices via "File > Preferences")
Change sampling rate
Filter the data
Re-reference the data
Interpolate electrodes
Inspect/reject data by eye
Reject data using Clean Rawdata and ASR
Decompose data by ICA
Inspect/label components by map
Classify components using ICLabel
Remove components from data
Extract epochs
Remove epoch baseline
Locate dipoles using DIPFIT
SIFT
eERP
Filename: none
Channels per frame 69
Frames per epoch 300
Epochs 143
Events 286
Sampling rate (Hz) 1000
Epoch start (sec) -0.050
Epoch end (sec) 0.249
Reference unknown
Channel locations Yes
ICA weights No
Dataset size (Mb) 13.2
Type here to search
11:42
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#5: AEP_filt_elist_be_ar
Filename: none
Channels per frame 69
Frames per epoch 300
Epochs 143
Events 286
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations Yes
ICA weights No
Dataset size (Mb) 13.2
Reject epochs by visual inspection -- pop_eegplot()
Add to previously marked rejections? (checked=yes)
Reject marked trials? (checked=yes)
Help
Cancel
OK
Type here to search
11:42
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#5: AEP_filt_elist_be_ar
Scroll channel activities -- eegplot()
Figure Display Settings Help
Stack
Norm
Scale
64
CANCEL
Event types
Chan Time Value
Trigger 154 9889 3345.3
REJECT
Type here to search
11:42
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#5: AEP_filt_elist_be_ar
Filename: none
Channels per frame 69
Frames per epoch 300
Epochs 143
Events 286
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations Yes
ICA weights No
Dataset size (Mb) 13.2
Reject pre-labelled epochs -- pop_rejepoch()
Are you sure, you want to reject the labeled trials ?
No
Yes
Type here to search
11:42
18-09-2020





So, here if you see, see this, here the red colored the this red colored this selected channels over here they are called, they are the rejected ones. Here these red-colored ones, are the rejected categories. So, we can just check how many of them are being rejected, how many are being accepted, we can check in the command window.

So over here, we have selected so many channels, in this channel almost 150, 125 of them are being accepted. Like means, which means that of in that particular voltage range, for these particular channels alone, these many, so these 125 events or the triggers are being or these many epochs are being accepted and 18 of them are being rejected. So, this usually it will be, it will be

like a 80-20 percent like this only it will be. Because there will be a lot of artifacts as, as I mentioned.

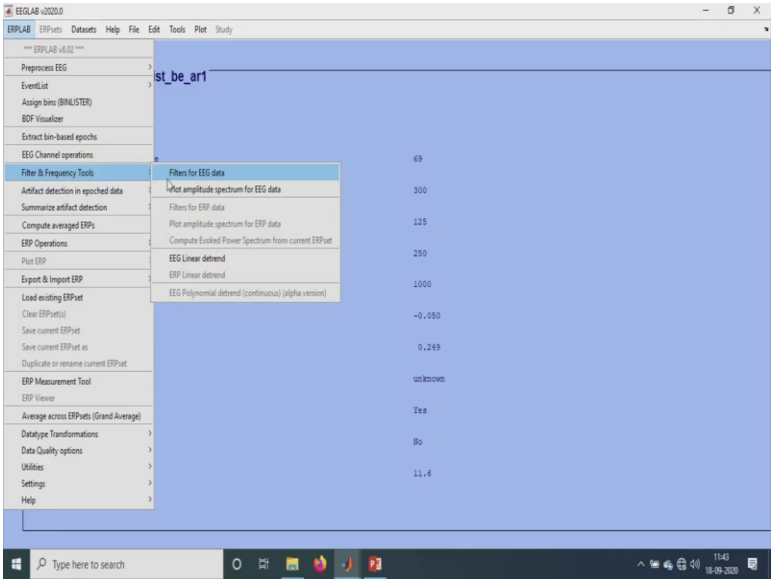
So then what happens is, if you, as I told you, if you do that trigger channels, if you select then, then the whole set of all the triggers will be rejected. For example, this whole of 143 epochs will would come in the rejected range. So that should not happen, so that is why we do not take the trigger and EMG, EKG channels and all.

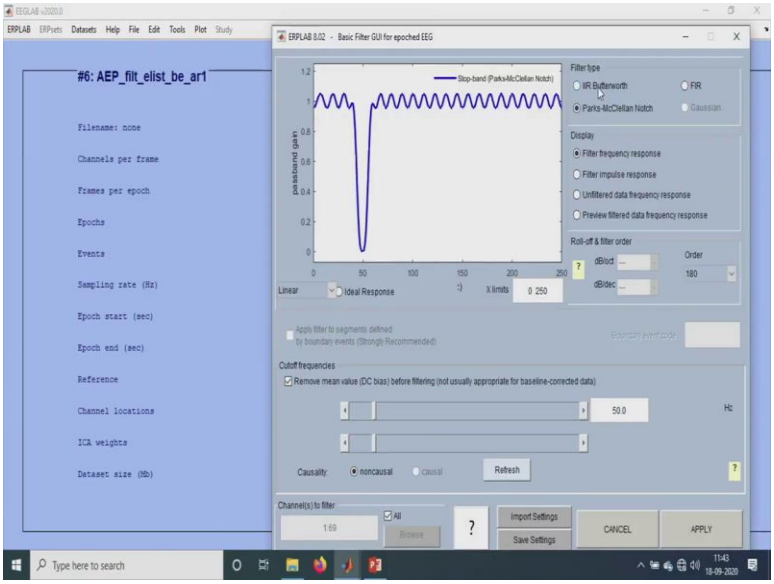
So over here, we have to, we can just, I will just show you how does it look. So, I will just take 20 epochs, over this 20 epochs, see all these yellow little colored things and all are been in the reject range. So, it is seen that there are lot of noise in this region. So, that is why it is in the reject, we can reject all these channels.

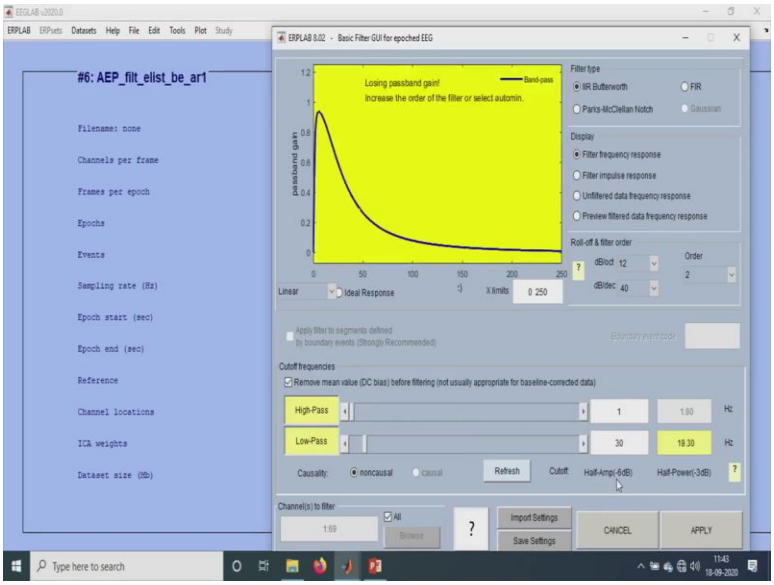
So, I will just do an update mark. So, it what it does is it updates, it will take that, these channels are the ones which have to be rejected. So, we can go to this tools, and then we can just select this inspect, reject data by eye and then we can just mark this reject channels and so, what happens is all these channels as I shown that all the yellow coloured channels, it all will get rejected. So here, if I do just this reject, it will ask again and we can just reject it off.

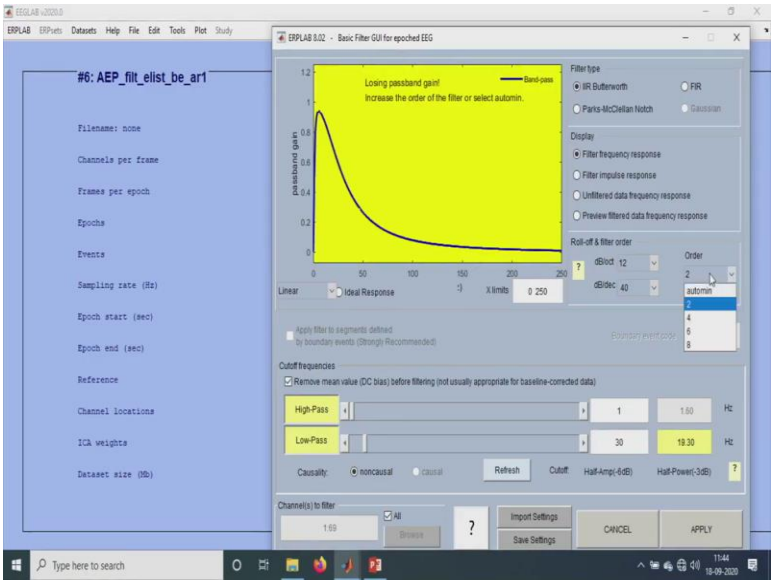
So, if you see over here, see over that 125, over 143 events, only 18 of them were being rejected. So, all those 18 trials are being rejected like that it will show and then it will create a new data set and we just save it in this format. So, this is how the artifact rejection has been done.

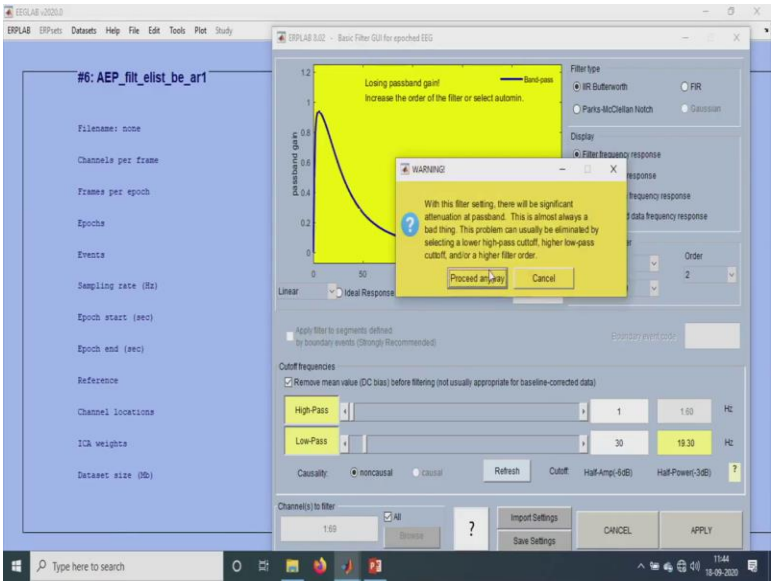
(Refer Slide Time: 18:13)






EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#6: AEP_filt_elist_be_ar1
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
ERPLAB 8.02 - Basic Filter GUI for epoched EEG
Losing passband gain!
Increase the order of the filter or select automin.
Band-pass
passband gain
Filter type
IIR Butterworth
FIR
Parks-McClellan Notch
Gaussian
Display
Filter frequency response
Filter impulse response
Unfiltered data frequency response
Preview filtered data frequency response
Roll-off & filter order
dBoct 12
dBdec 40
Order
2
Linear
Ideal Response
X limits 0 250
Apply filter to segments defined by boundary events (Strongly Recommended)
Boundary event code
Cutoff frequencies
Remove mean value (DC bias) before filtering (not usually appropriate for baseline-corrected data)
High-Pass
1
1.60
Hz
Low-Pass
30
19.30
Hz
Causality:
noncausal
causal
Refresh
Cutoff:
Half-Amp(-6dB)
Half-Power(-3dB)
Channel(s) to filter
1:69
All
Browse
Import Settings
Save Settings
CANCEL
APPLY
Type here to search
11:43
18-09-2020

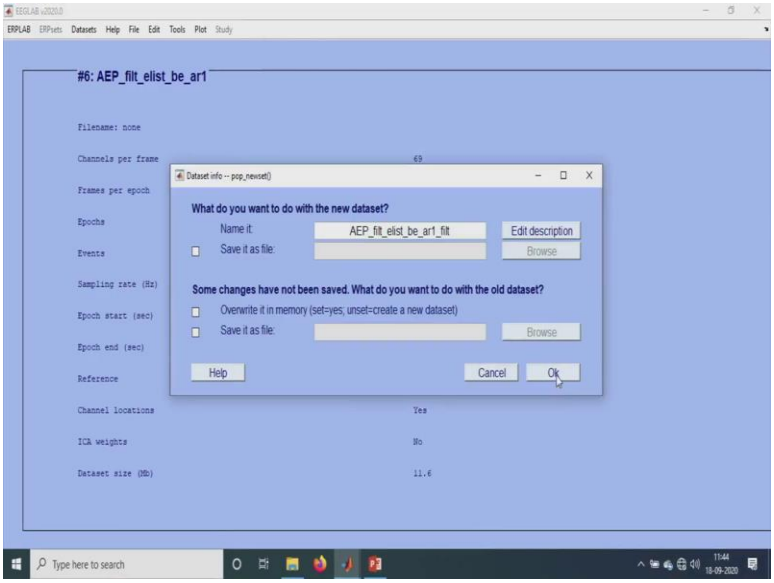

EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#6: AEP_filt_elist_be_ar1
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
ERPLAB 8.02 - Basic Filter GUI for epoched EEG
Losing passband gain!
Increase the order of the filter or select automin.
Band-pass
passband gain
Filter type
IIR Butterworth
FIR
Parks-McClellan Notch
Gaussian
Display
Filter frequency response
Filter impulse response
Unfiltered data frequency response
Preview filtered data frequency response
Roll-off & filter order
dBoct 12
dBdec 40
Order
2
automin
2
4
6
8
Linear
Ideal Response
X limits 0 250
Apply filter to segments defined by boundary events (Strongly Recommended)
Boundary event code
Cutoff frequencies
Remove mean value (DC bias) before filtering (not usually appropriate for baseline-corrected data)
High-Pass
1
1.60
Hz
Low-Pass
30
19.30
Hz
Causality:
noncausal
causal
Refresh
Cutoff:
Half-Amp(-6dB)
Half-Power(-3dB)
Channel(s) to filter
1:69
All
Browse
Import Settings
Save Settings
CANCEL
APPLY
Type here to search
11:44
18-09-2020



Next, what we will do is we have to do the filtering again. So before, because even after we did not do any filter while acquiring the data, we have done some filtering options, but even during the data processing also we need to do all the data filtering steps. So, we will do the data using this Butterworth filter.

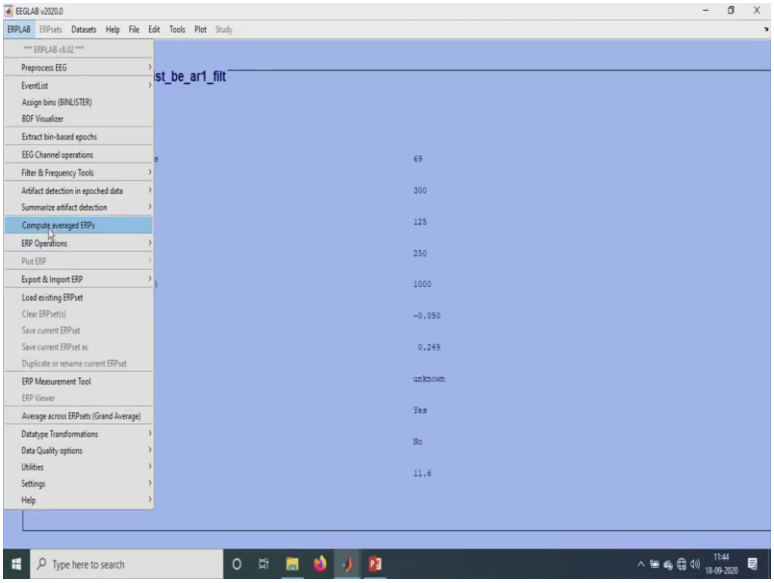
So, we usually take from 1 to 30, usually, this is the range in which we do the bandpass filtering. If you want, we can change the order of the, of fitter or we can change the upper limit or the lower limit like it can be minus 4.1 or it can be more than 30 also. So, it depends on the what, what kind of epochs you are taking or what kind of AEP or EAP, how whichever, whichever ERP we take, it depends on that. So, we just apply it.

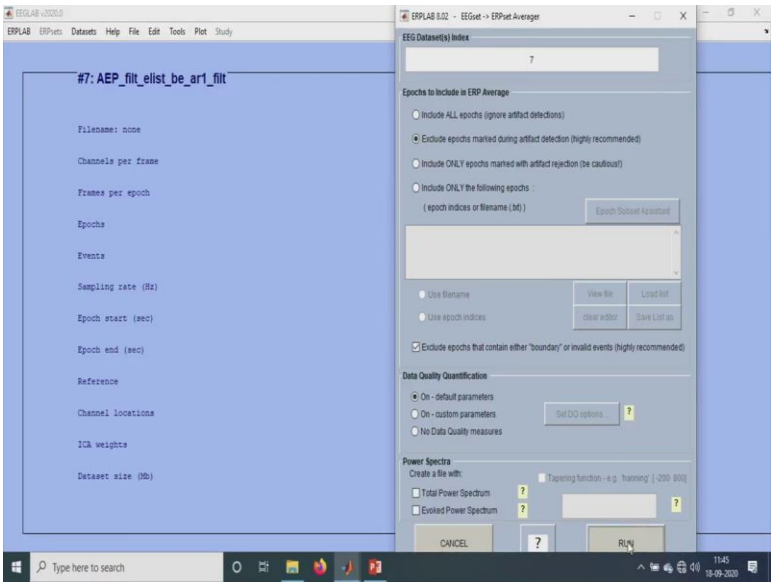
(Refer Slide Time: 19:22)



So, as you apply you will have the filtering being done. So, after these filters, now we have totally 125 epochs are been there, now these 25 epochs, I want to be averaged all together and to obtain the ERPs. Now, each of this time epochs we have to together, average together and get one particular waveform, that is called as, that is this averaging step.

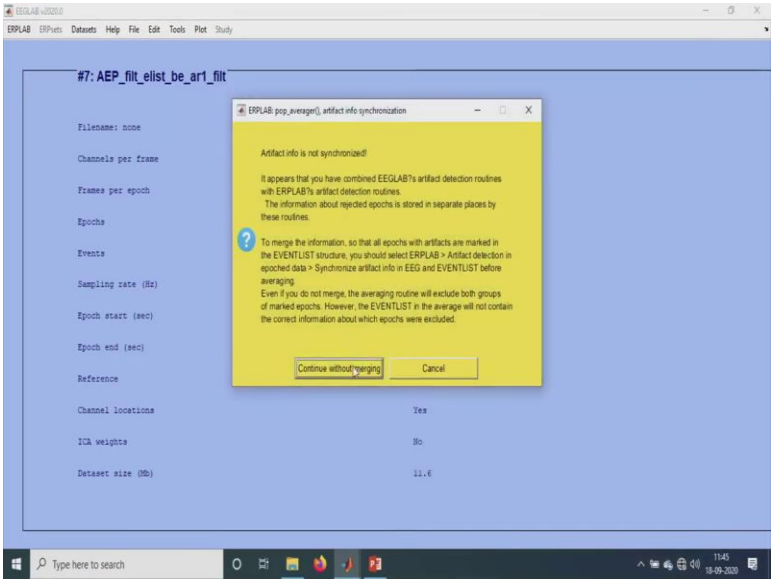
(Refer Slide Time: 19:48)

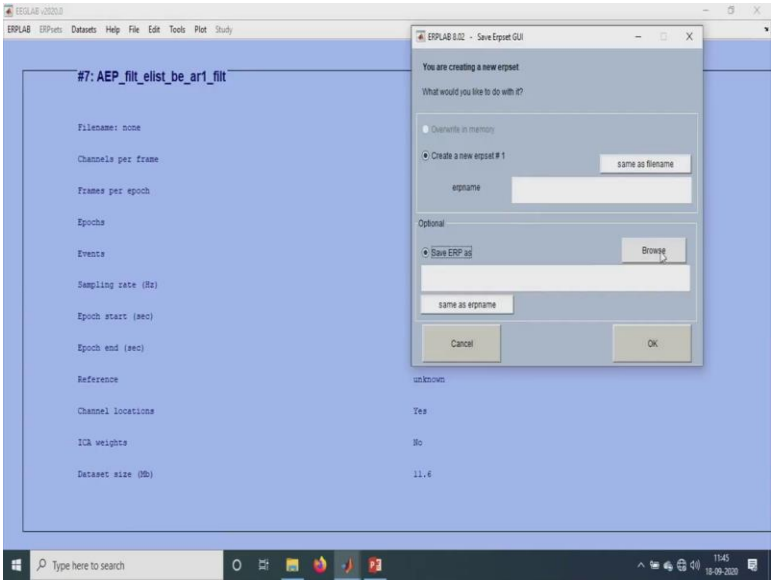


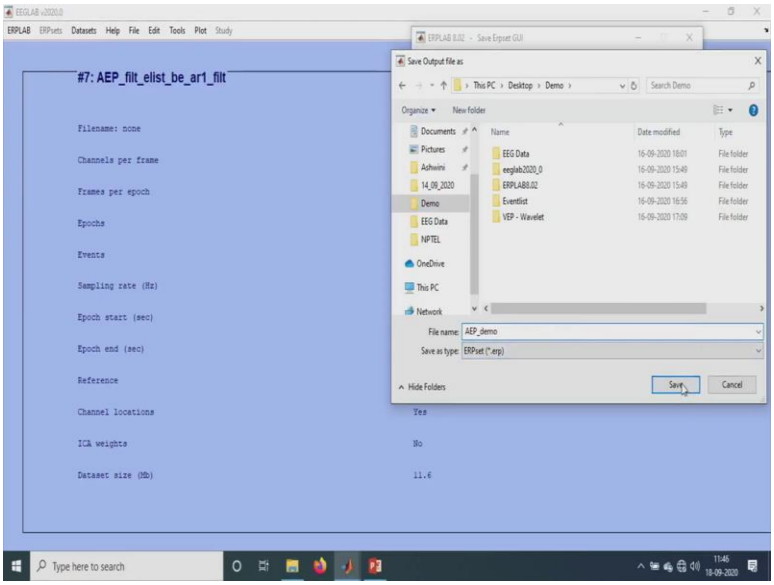


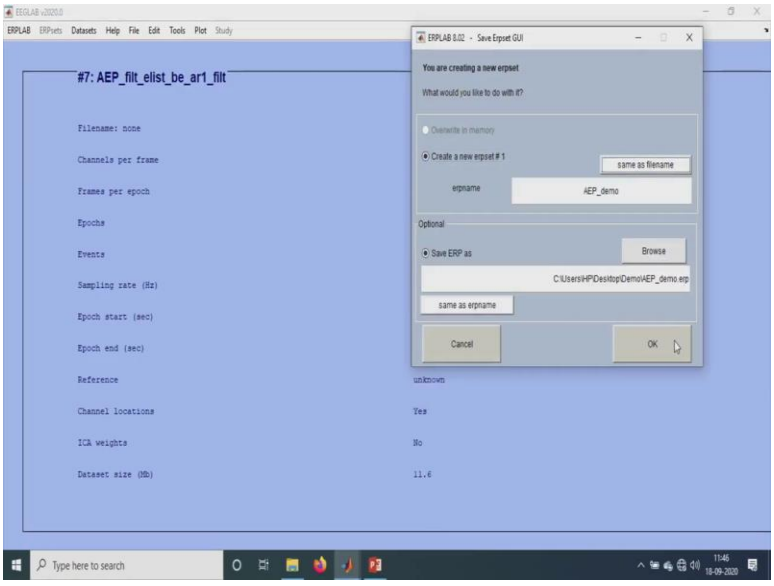
So, here we do this compute average, ERP average DRPs. So, when we do that, we do for this seventh data set, so that our seventh data set will have 125 epoch, so those we can do and can do any of it spectrum analysis or if you want to know the total spectrum FFTs and all etc, we can do and this particular, this particular option should be selected because we do not want any of the artifact rejected epochs to be average. So, this particular bit will exclude all the epochs that has been rejected by the artifact rejection.

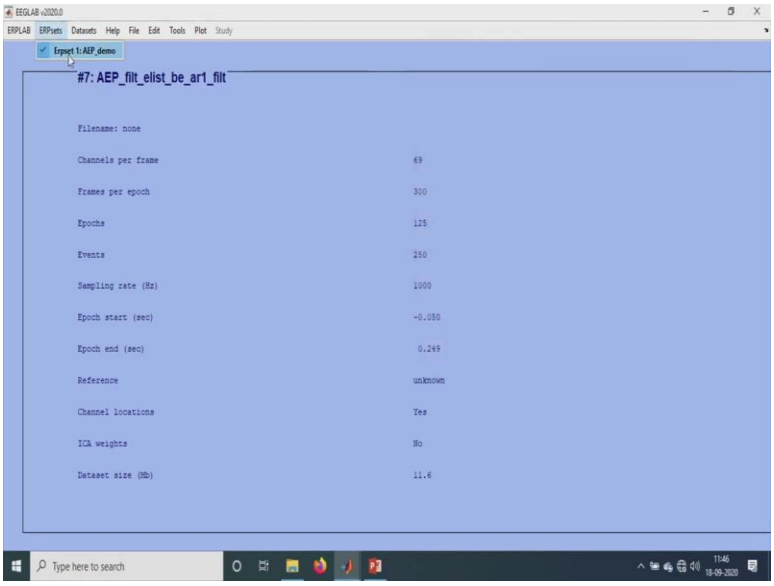
(Refer Slide Time: 20:30)





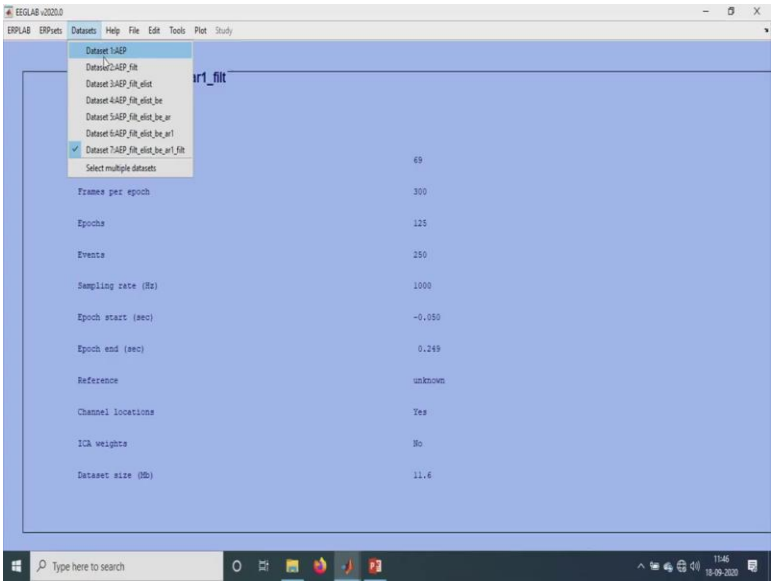

EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Yes
No
11.6
ERPLAB 8.02 - Save Erpset GUI
Save Output File as
This PC › Desktop › Demo ›
Search Demo
Organize
New folder
Documents
Pictures
Ashwini
14_09_2020
Demo
EEG Data
NPTEL
OneDrive
This PC
Network
Name
Date modified
Type
EEG Data 16-09-2020 18:01 File folder
eeglab2020_0 16-09-2020 15:49 File folder
ERPLAB8.02 16-09-2020 15:49 File folder
Eventlist 16-09-2020 16:56 File folder
VEP - Wavelet 16-09-2020 17:09 File folder
File name: AEP_demo
Save as type: ERPset (*.erp)
Hide Folders
Save
Cancel
Type here to search
11:46
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
unknown
Yes
No
11.6
ERPLAB 8.02 - Save Erpset GUI
You are creating a new erpset
What would you like to do with it?
Overwrite in memory
Create a new erpset # 1
same as filename
erpname
AEP_demo
Optional
Save ERP as
Browse
C:\Users\HP\Desktop\Demo\AEP_demo.erp
same as erpname
Cancel
OK
Type here to search
11:46
18-09-2020



So then, if you just run it, this is just a heads on, like it is just giving that we are the EGLAB and ERPLAB it has to be synchronized, for that purpose that shows. But even if you do not do the synchronization step also, it will give the proper result itself. So over here, so we just save it wherever we want, I will just name it as a AEP demo, so I just name it in this manner. So, we can just save the ERPs, we can save this ERPs in this format and we can. So as you do that, here we have the ERPs been produced over here.

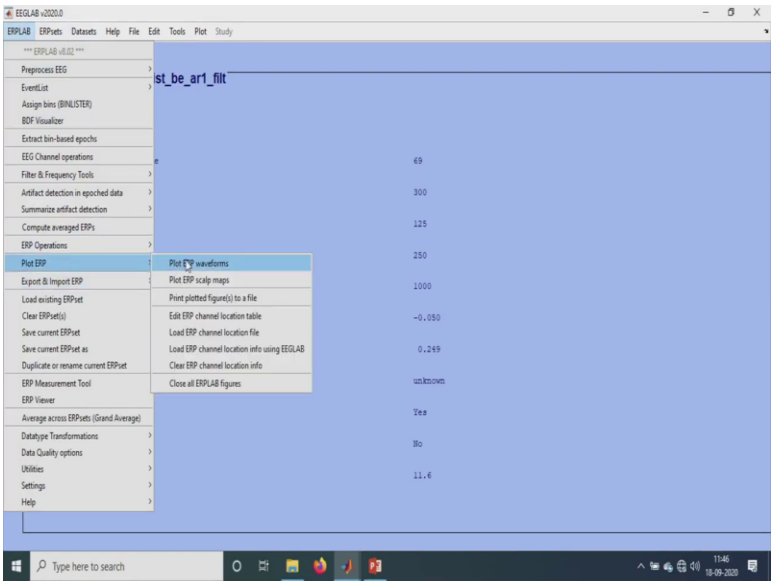
(Refer Slide Time: 21:09)

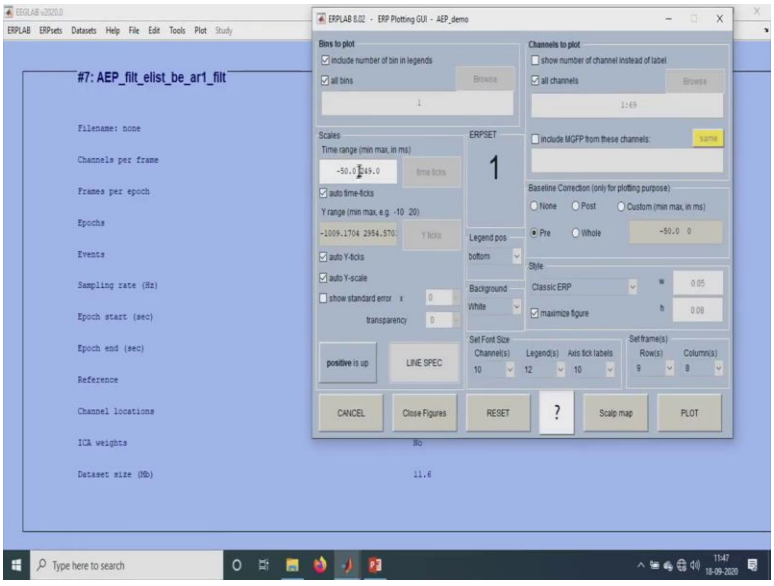


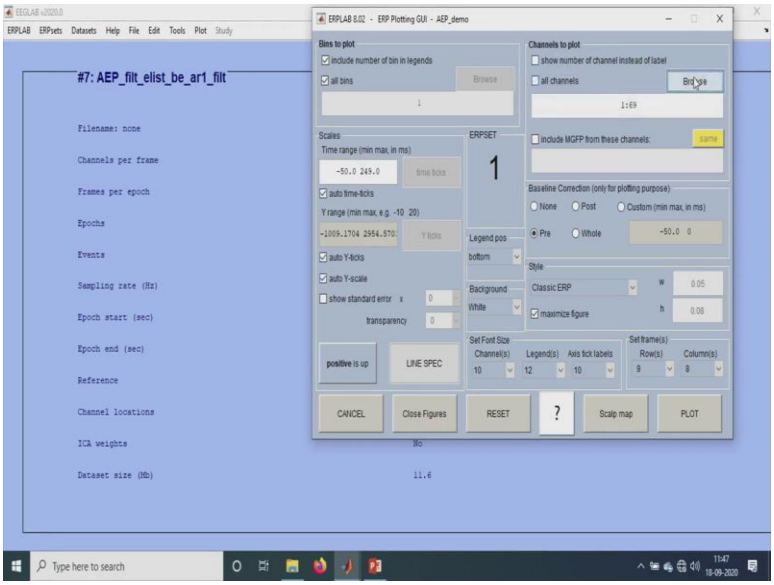
So, before, before doing all those steps, this was the first importing AEP, the next we did the notch filter, and then we did the event, the event list creation, then we did the epoching of in this

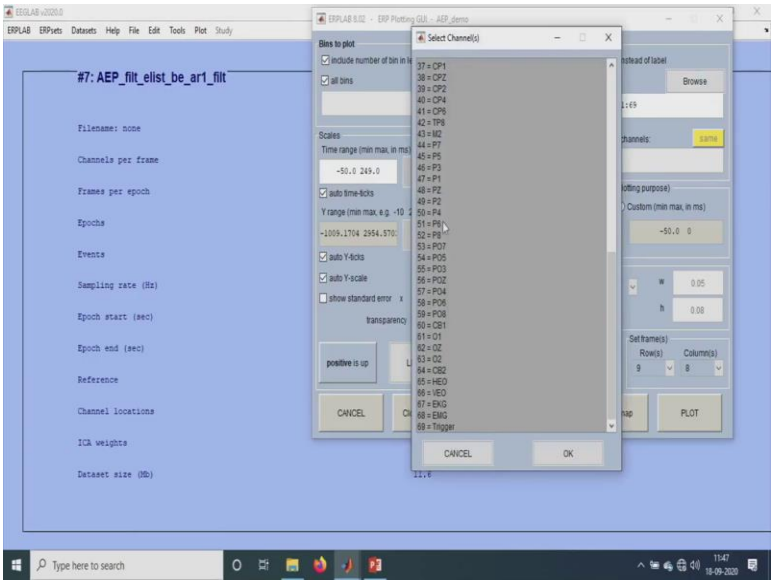
place, and then we did the artifact rejection, then we just removed all the rejected data and finally, we did the lastly, we did another bandpass filter. So, these are the step, sequential steps and this particular, in this data set we did the averaging and we did the ERP. So, this is the ERP set that has been made over it.

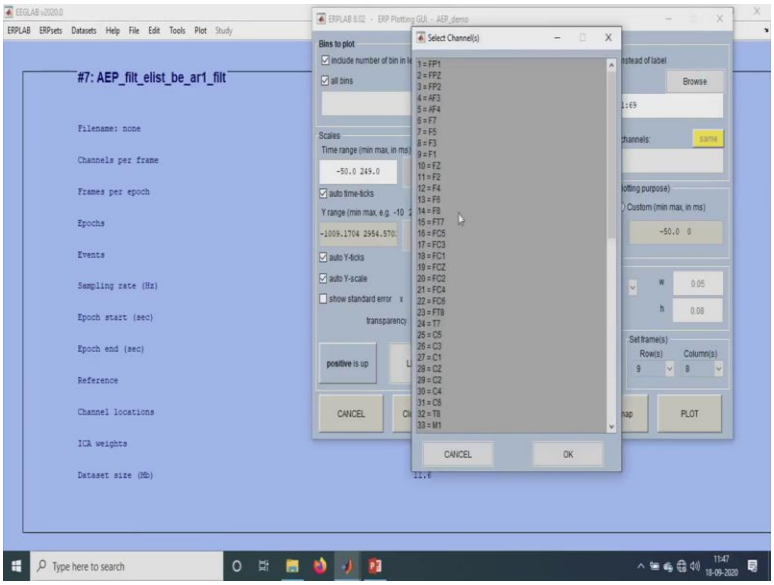
(Refer Slide Time: 21:43)

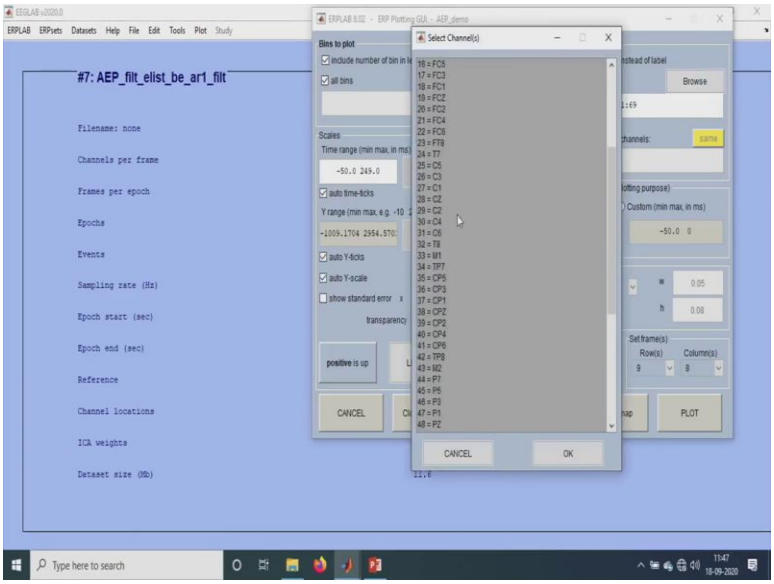


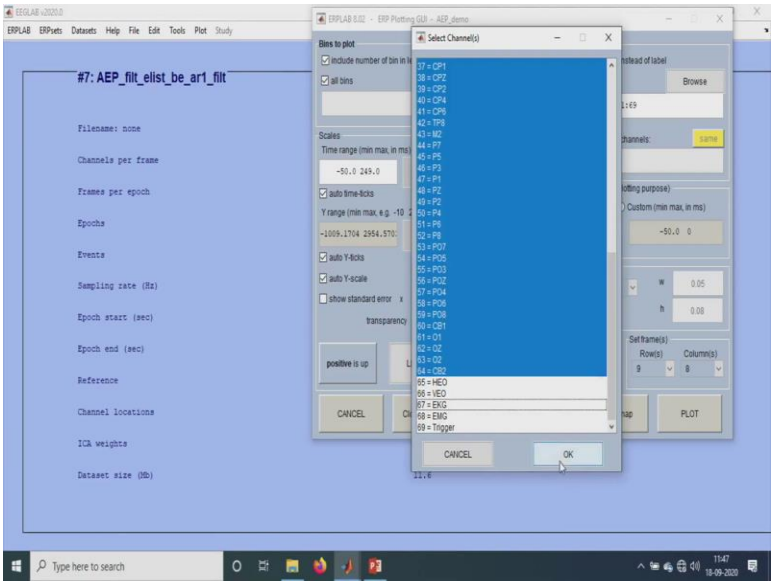


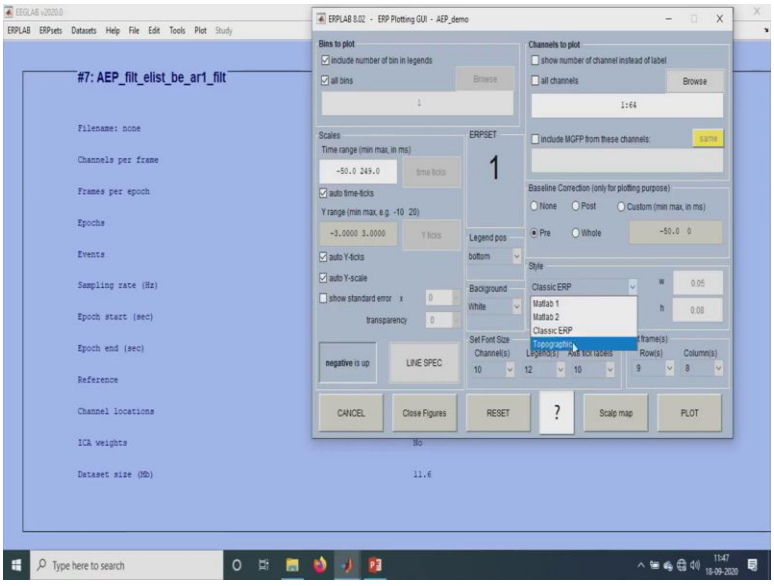

EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
11.6
ERPLAB 8.02 - ERP Plotting GUI - AEP_demo
Bins to plot
include number of bin in legends
all bins
Browse
Channels to plot
show number of channel instead of label
all channels
1:69
include MGFP from these channels:
same
Scales
Time range (min max, in ms)
-50.0 249.0
time ticks
auto time-ticks
Y range (min max, e.g. -10 20)
-1009.1704 2954.570
Y ticks
auto Y-ticks
auto Y-scale
show standard error
transparency
ERPSET
1
Legend pos
bottom
Background
White
Baseline Correction (only for plotting purpose)
None
Post
Custom (min max, in ms)
Pre
Whole
-50.0 0
Style
Classic ERP
maximize figure
w
0.05
h
0.08
positive is up
LINE SPEC
Set Font Size
Channel(s)
Legend(s)
Axis tick labels
Set frame(s)
Row(s)
Column(s)
CANCEL
Close Figures
RESET
?
Scalp map
PLOT
Type here to search
11:47
18-09-2020

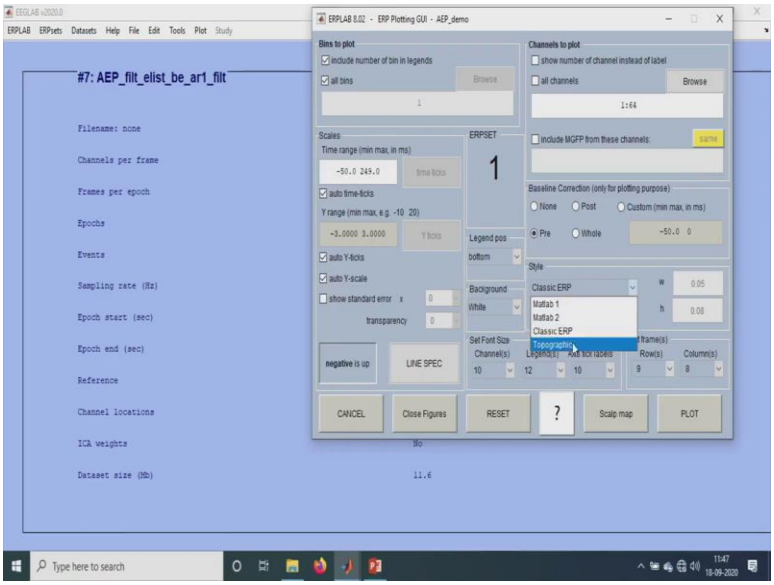

EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Select Channel(s)
37 = CP1
38 = CPZ
39 = CP2
40 = CP4
41 = CP6
42 = TP8
43 = M2
44 = P7
45 = P5
46 = P3
47 = P1
48 = PZ
49 = P2
50 = P4
51 = P6
52 = P8
53 = PO7
54 = PO5
55 = PO3
56 = POZ
57 = PO4
58 = PO6
59 = PO8
60 = CB1
61 = O1
62 = OZ
63 = O2
64 = CB2
65 = HEO
66 = VEO
67 = EKG
68 = EMG
69 = Trigger
CANCEL
OK
Browse
same
Custom (min max, in ms)
-50.0 0
w
0.05
h
0.08
Set frame(s)
Row(s)
Column(s)
PLOT
Type here to search
11:47
18-09-2020

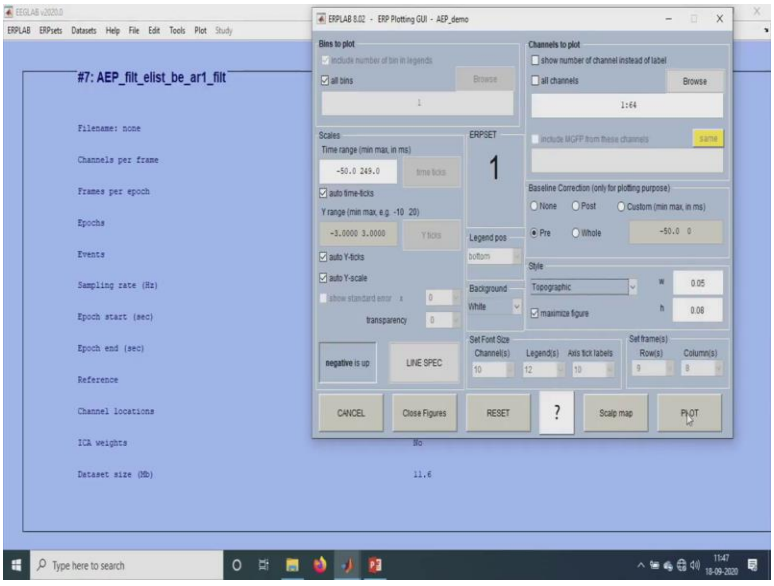

#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Select Channel(s)
1 = FP1
2 = FPZ
3 = FP2
4 = AF3
5 = AF4
6 = F7
7 = F5
8 = F3
9 = F1
10 = FZ
11 = F2
12 = F4
13 = F6
14 = F8
15 = FT7
16 = FC5
17 = FC3
18 = FC1
19 = FCZ
20 = FC2
21 = FC4
22 = FC6
23 = FT8
24 = T7
25 = C5
26 = C3
27 = C1
28 = CZ
29 = C2
30 = C4
31 = C6
32 = T8
33 = M1
CANCEL
OK
PLOT
Type here to search


#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Select Channel(s)
16 = FC5
17 = FC3
18 = FC1
19 = FCZ
20 = FC2
21 = FC4
22 = FC6
23 = FT8
24 = T7
25 = C5
26 = C3
27 = C1
28 = CZ
29 = C2
30 = C4
31 = C6
32 = T8
33 = M1
34 = TP7
35 = CP5
36 = CP3
37 = CP1
38 = CPZ
39 = CP2
40 = CP4
41 = CP6
42 = TP8
43 = M2
44 = P7
45 = P5
46 = P3
47 = P1
48 = PZ
CANCEL
OK
PLOT
Type here to search


#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Select Channel(s)
37 = CP1
38 = CPZ
39 = CP2
40 = CP4
41 = CP6
42 = TP8
43 = M2
44 = P7
45 = P5
46 = P3
47 = P1
48 = PZ
49 = P2
50 = P4
51 = P6
52 = P8
53 = PO7
54 = PO5
55 = PO3
56 = POZ
57 = PO4
58 = PO6
59 = PO8
60 = CB1
61 = O1
62 = OZ
63 = O2
64 = CB2
65 = HEO
66 = VEO
67 = EKG
68 = EMG
69 = Trigger
CANCEL
OK
CANCEL
PLOT
Type here to search


#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
ERPLAB 8.02 - ERP Plotting GUI - AEP_demo
Bins to plot
include number of bin in legends
all bins
Browse
Channels to plot
show number of channel instead of label
all channels
Browse
1:64
Scales
Time range (min max, in ms)
-50.0 249.0
auto time-ticks
Y range (min max, e.g. -10 20)
-3.0000 3.0000
auto Y-ticks
auto Y-scale
show standard error
transparency
negative is up
LINE SPEC
ERPSET
1
Legend pos
bottom
Background
White
Classic ERP
Matlab 1
Matlab 2
Classic ERP
Topographic
Baseline Correction (only for plotting purpose)
None
Post
Custom (min max, in ms)
Pre
Whole
-50.0 0
Style
Set Font Size
Channel(s)
Legend(s)
Axis tick labels
Row(s)
Column(s)
CANCEL
Close Figures
RESET
?
Scalp map
PLOT
Type here to search



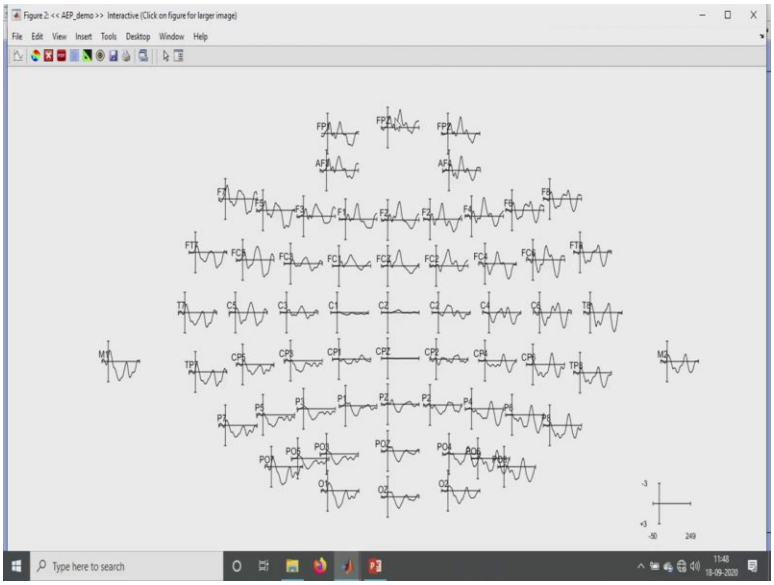


Next, next we want to plot how this, does it look. So, here we have the plot ERPs, in this we can, this is the, this is how it looks. So here, we have the time range from minus 50, so first we did the epoching from minus 50 to 250, so that is why it looks like this and here are the channels and all we do not require the whole of this trigger channels and everything, so we just remove all these channels because it is not needed for us.

We just require the other channels and we can obtain the topographic how would, like how it looks in the head in that way itself we can obtain this and as I told you always, we have to check this negative up for the say in one data. So, then I will just do a topographic here, we can have

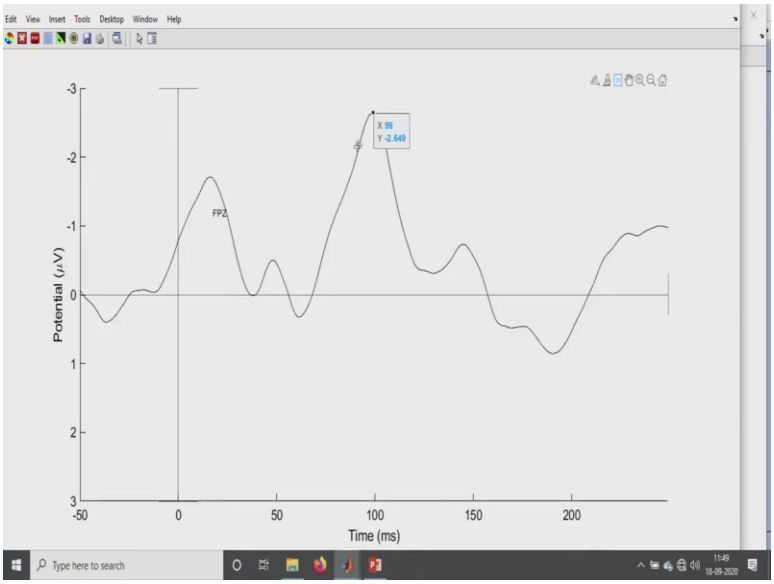
different style in which we can have the waveform. So, I will take topographic and I will just plot it.

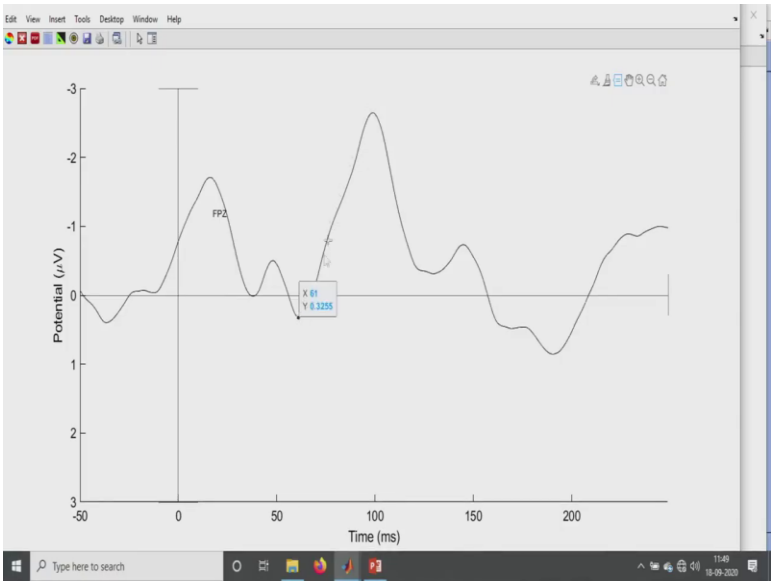
(Refer Slide Time: 22:55)

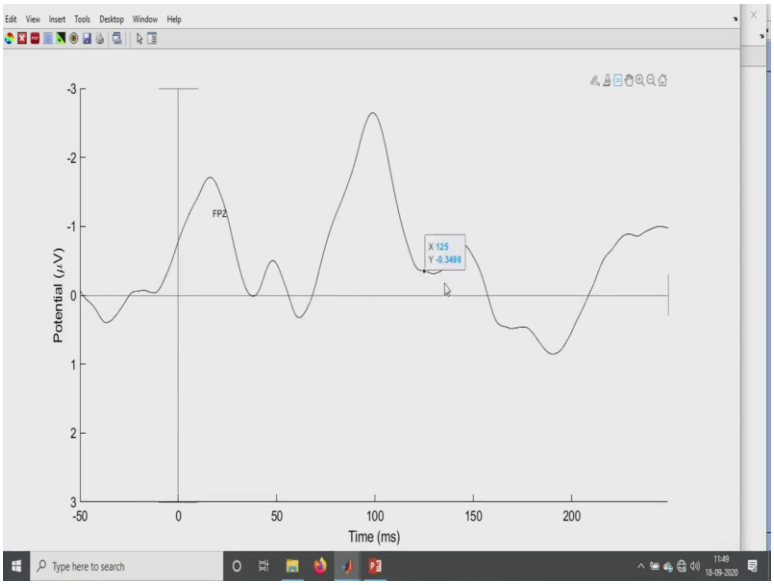


So, if I plot it, you will get the, how is in the, how it looks in the head like that itself you will be getting the data. So, this is how it looks like for, so here these are the frontal, this is the frontal electrodes, this is the no side, the no side electrodes are the inion side, this is the inion side and over here, here this is the temporal lobes, here we have the frontal these are the frontal part and this is the parietal and finally, this last level here we have the temporal row, the occipital lobes.

(Refer Slide Time: 23:47)



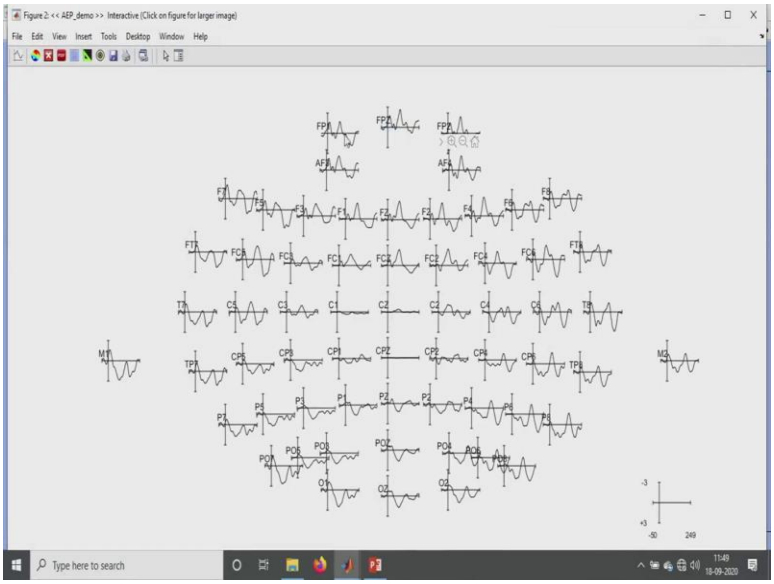


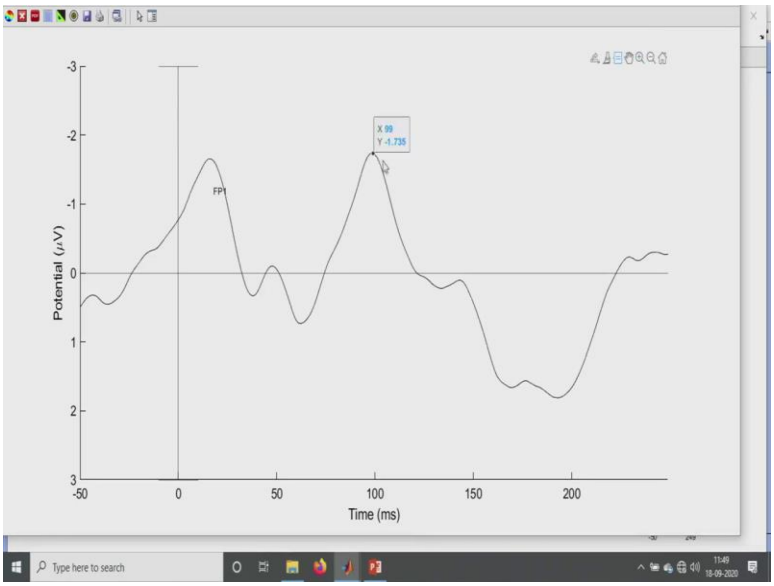


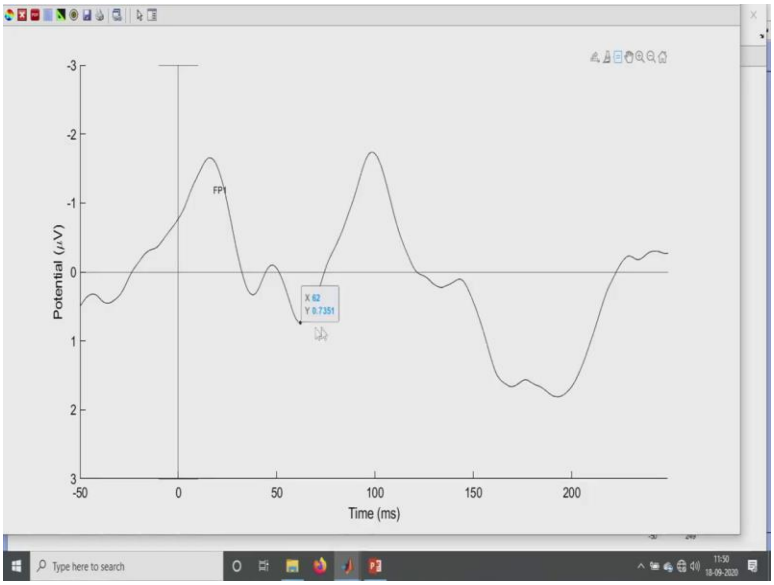
So, mainly as I told you, the AEPs will have and the frontal as well as in the temporal areas. So, I will just show you a particular data set only, for example, mostly we check all the midline electrodes and this temporal electrode and all usually. So, if we just click one of this, we will get a larger version of the thing. So, as I told you, I have made it in the negative up, as a negative up I have done.

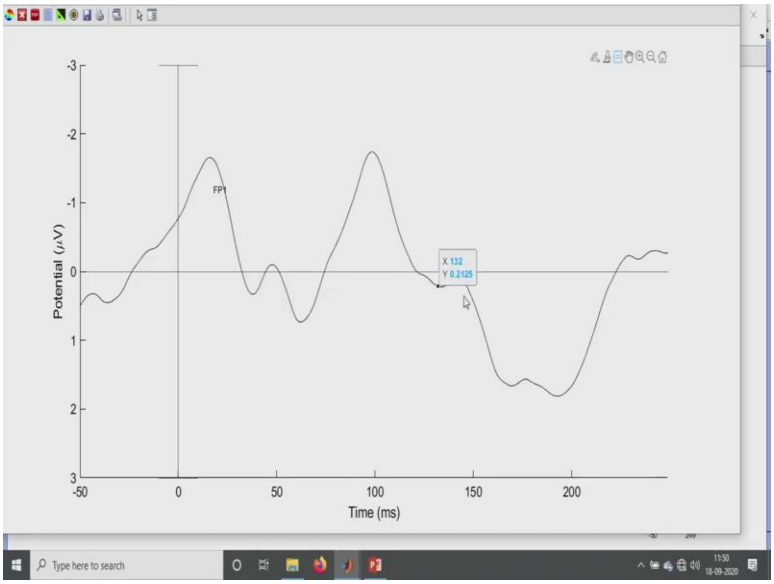
So, here as I said here, this particular peak is a n1 peak, this particular peak, it is the n1 peak. The one which proceeds n1 peak that is called as the P1 and the one which comes the next of it here, this particular peaks over here that is called as the P2 peak. So, this is, particular this whole area is called as the LPC complex. So, this is, this will be there and now the auditory or even if you do an MMN also you will have this particular data. So, this is a classic example of an AEP.

(Refer Slide Time: 24:30)









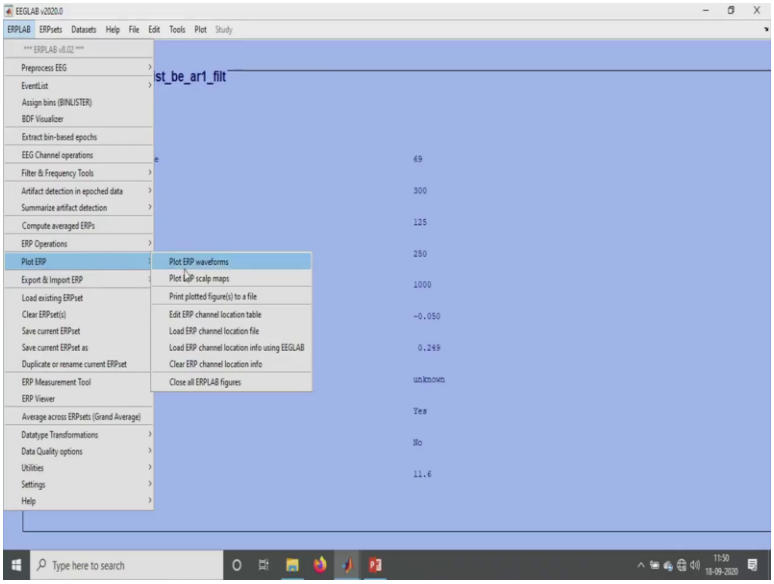
So, like that we can visualize for each electrode every electrodes we can visualize a similar thing. So, for example, if I want to check this, even in this also you can open it. So, if you open it, so here we have the peaks obtained over here as well.

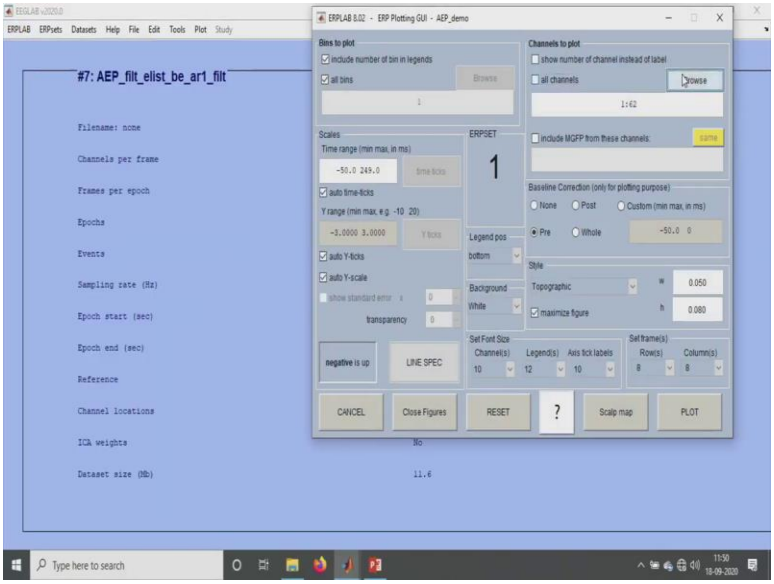
So, here we have this is the proper n1 peak. So, it is correctly at 100, so this is the n1 and here we have the P1. The preceding one is a P1, and the next one is P2. So, here it can be P2. So, like that we can visualize for each channels and then we can do some, and if you see from here, this is a frontal and this is the occipital that is from here to here.

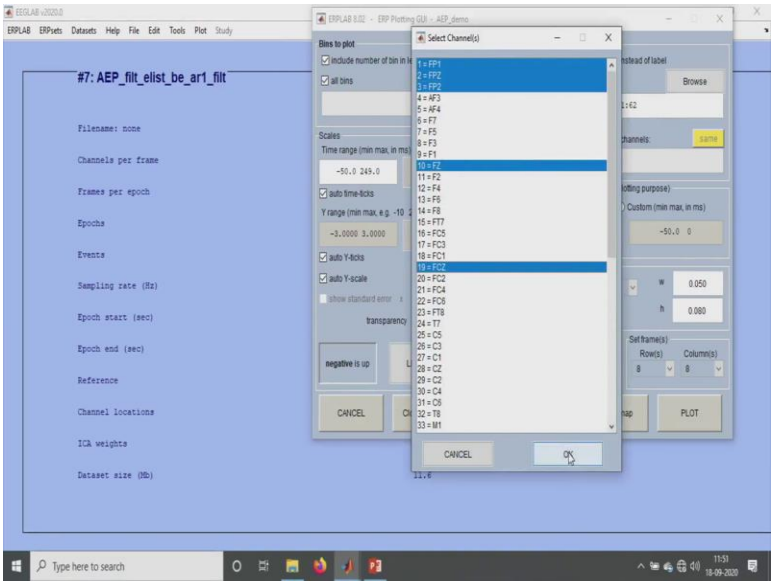
So, what happens is, there is a proper dipole inversion that has been taking place, here however it looks, it is the exact opposite it will be there in this. So, it says that, the brain is also acts like a

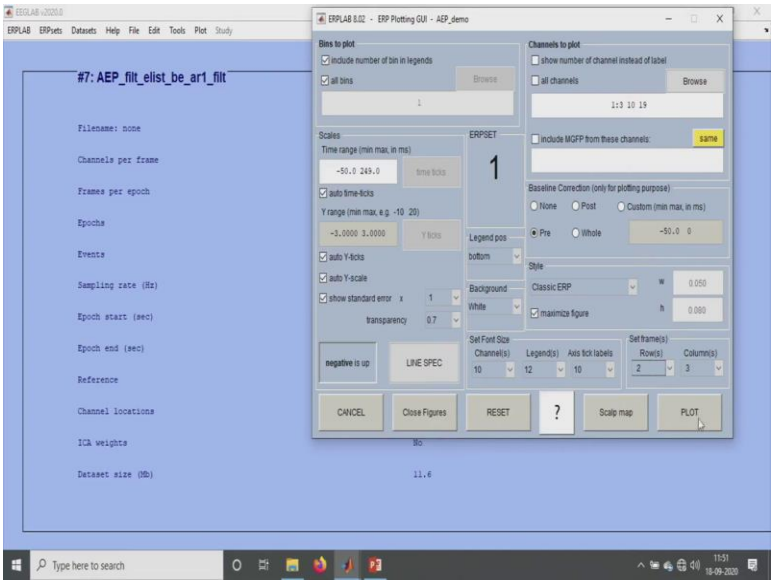
dipole, it, it is just indicating that thing. Now, if you want, this is a topographic analysis kind of thing.

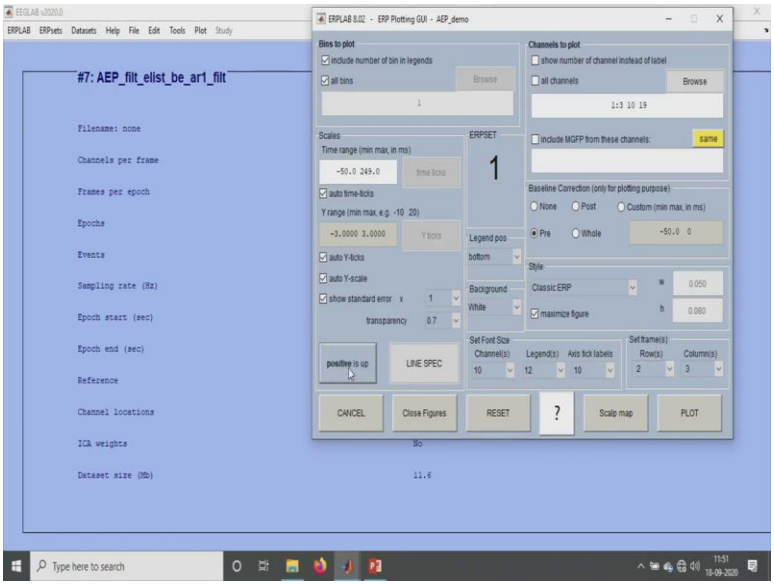
(Refer Slide Time: 25:39)






#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Select Channel(s)
CANCEL
OK
PLOT
Type here to search

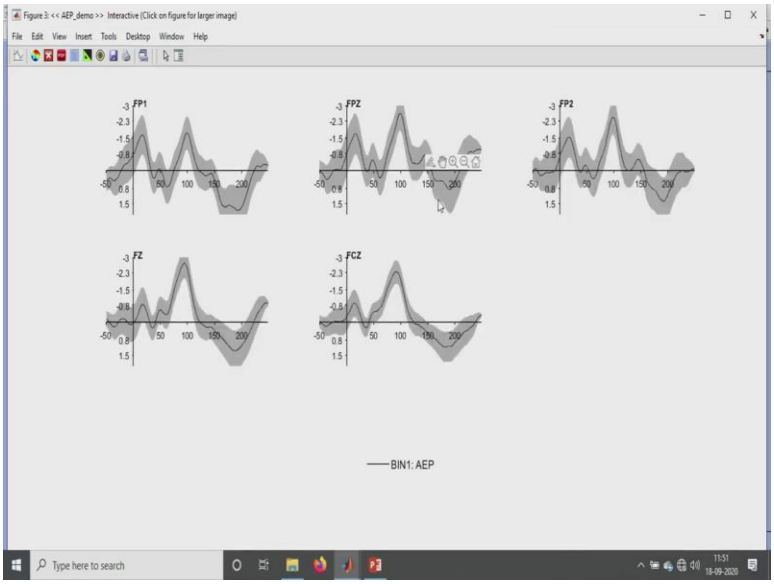

#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
ERPLAB 8.02 - ERP Plotting GUI - AEP_demo
CANCEL
Close Figures
RESET
Scalp map
PLOT
Type here to search



Now, we can have it as individual waveforms also, in that we can do some statistical analysis also can be done. So, I will just take this 3 electrodes and some of the central electrodes, this just take this 3, 5 electrodes for now and we can have the standard errors of the mean, what is the standard errors of mean, they are called as the, it is a statistical analysis, which should gives a how accurate our data looks.

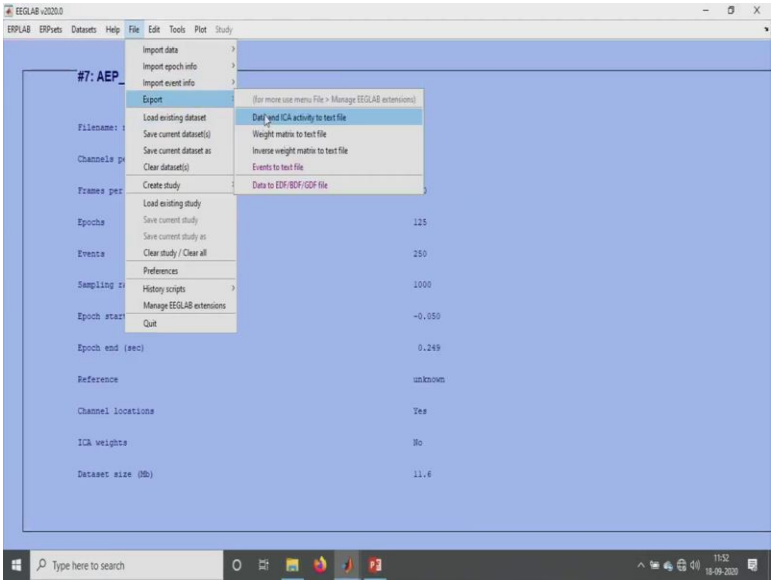
So, if thicker the band, it means it is a bit less accure, if it is very thin, then it is called as it is more accure data we can say. So I will just have 5 electrodes, so I will just take in this manner. We can set how many hours number of rows we want, how many columns we want, always we can, we can make it negative up also and positive up also. So, I will just make it negative up for our analysis for this AEP analysis, and we can just plot it.

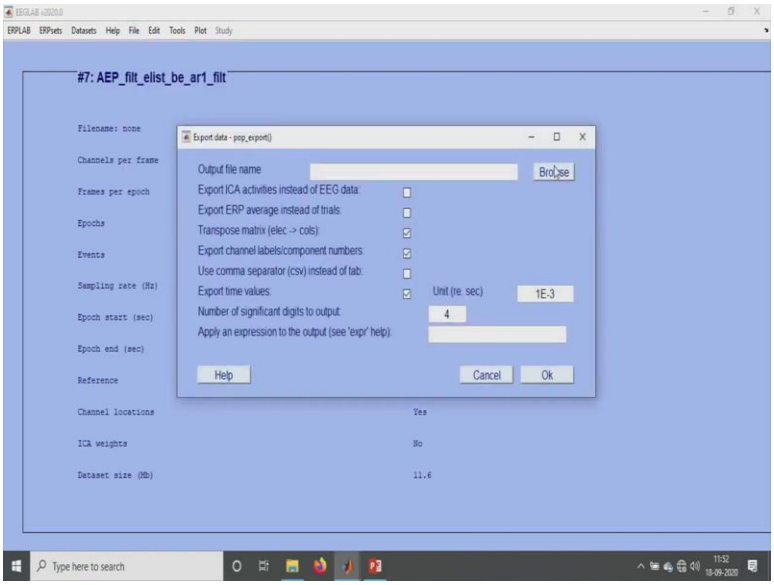
(Refer Slide Time: 26:39)

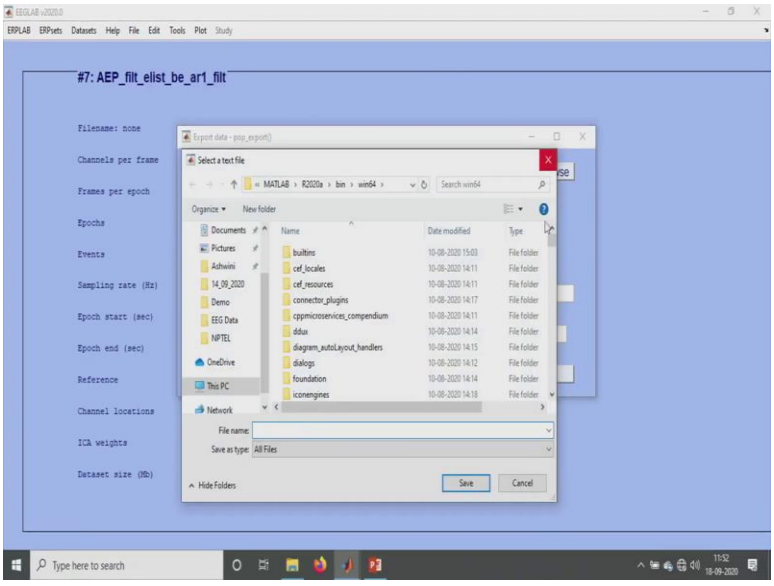


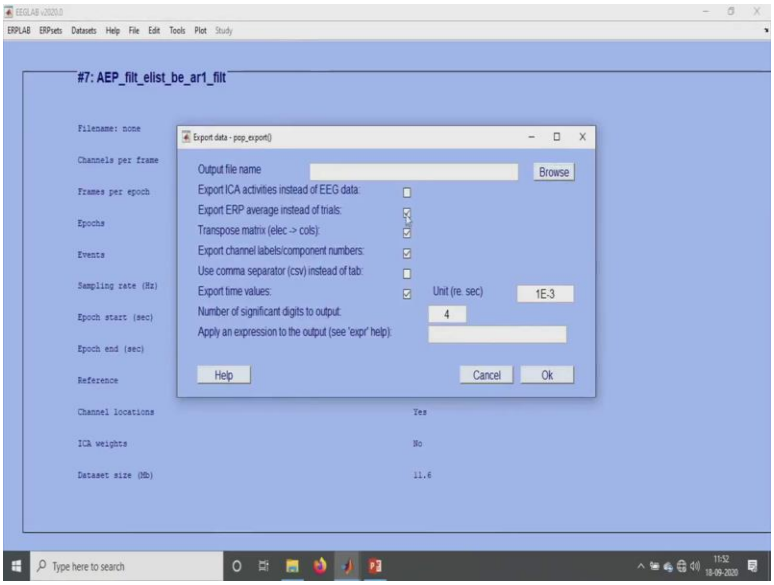
So, this is how it looks. So, this grey portion is called the standard errors of the mean. So, here we have the individual this one, so like that we can take for all the electrodes also, I just thought this is prominently we have seen, we can see the n1 P1 peak and all, so that is why I just chose these electrodes. So, like this we can do for other, other MMN, P300, and even VP also, I will show the demo for each and everything.

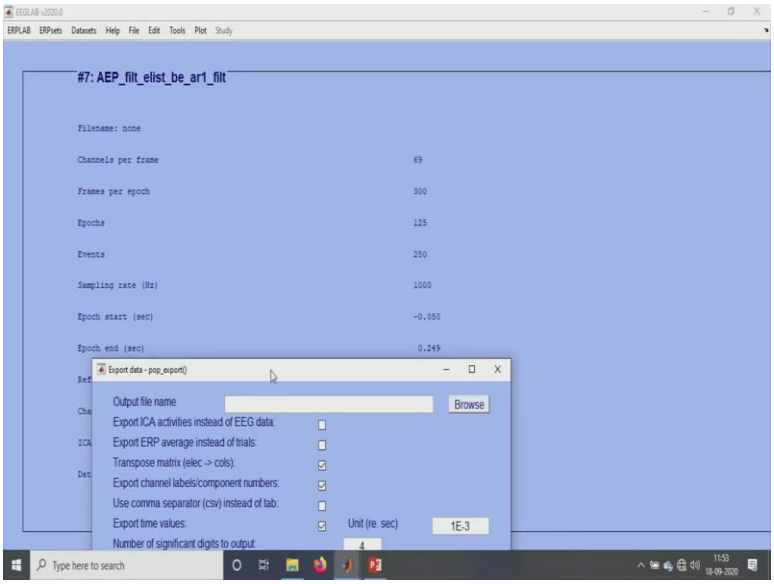
(Refer Slide Time: 27:13)




EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Yes
No
11.6
Export data - pop_export()
Output file name:
Browse
Export ICA activities instead of EEG data:
Export ERP average instead of trials:
Transpose matrix (elec -> cols):
Export channel labels/component numbers:
Use comma separator (csv) instead of tab:
Export time values:
Unit (re. sec)
1E-3
Number of significant digits to output:
4
Apply an expression to the output (see 'expr' help):
Help
Cancel
Ok
Type here to search
11:52
18-09-2020


EEGLAB v2020.0
ERPLAB ERPsets Datasets Help File Edit Tools Plot Study
#7: AEP_filt_elist_be_ar1_filt
Filename: none
Channels per frame
Frames per epoch
Epochs
Events
Sampling rate (Hz)
Epoch start (sec)
Epoch end (sec)
Reference
Channel locations
ICA weights
Dataset size (Mb)
Export data - pop_export()
Select a text file
« MATLAB › R2020a › bin › win64 ›
Search win64
Organize
New folder
Documents
Pictures
Ashwini
14_09_2020
Demo
EEG Data
NPTEL
OneDrive
This PC
Network
Name
Date modified
Type
builtins
cef_locales
cef_resources
connector_plugins
cppmicroservices_compendium
ddux
diagram_autoLayout_handlers
dialogs
foundation
iconengines
File name:
Save as type:
All Files
Hide Folders
Save
Cancel
Type here to search
11:52
18-09-2020

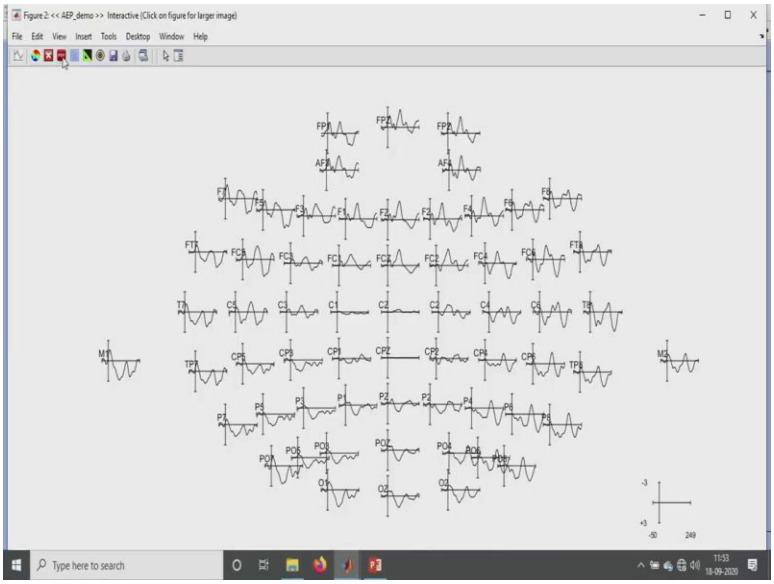




Another important step is, another thing is we can export this data, however, this datas are there we can export it in the text format or it can be an excel sheet or file. However, in whichever manner you want, you can just export it.

You can have that average ERP also, we, either if you want just the average ERP you just select this, if you want for all the parks like for 125 epochs for, for all the epochs if you want it will give in that manner and then these frames per epoch, which means that from minus 50 to 250 millisecond how the epochs, that is an epoch range and for that range, for each epoch there will be 300 data points will be there. So, that is what this frames per epoch mean. So, that is just information that I missed last. So, that is how we can export the data that is a thing.

(Refer Slide Time: 28:15)



And we can all these images which we obtained we can take it in the PDF format or we can just tell zoom in now anything you can do all the options and all can be done over here. So, this is about the AEP demonstration. So, next, I will be giving you demos about the MMN P300 and the way other ERPs. So, thank you.