### Neural Science for Engineers Prof. Vikas V National Institute of Mental Health and Neurosciences (NIMHANS) Indian Institute of Science, Bengaluru

## Lecture - 53 ERP extraction demonstration

Hi, welcome to the continuation module on ERP analysis. In last module, we have seen the introduction of ERP analysis and what are the applications, where you can use the ERP experimentation. We have also seen three different blocks; how to generate the stimuli, how to acquire the data, and how to extract the data? We have shown you one actual experimentation which is being happening, a glimpse of that.

So, the same experimentation we have recorded some data. So, in this particular short module we are going to see how we can use MATLAB to record that particular data and make sense out of it. So, if you can see my MATLAB screen.

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This particular data which has been stored using the acquisition. nedf file as I mentioned using that neuro electrics enobio eight cap saves the data in nedf file and so I ask you to download the eeglab.

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Now, if you download the eeglab, it comes like this.

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So, all these functions in different classification, miscellaneous functions are there, gui functions are there, pop functions are there, statistical functions are there, you can go and explore it at your own.

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Also, these are the plugins I mentioned different plugins are there. Now, if you want to operate or you know process the ERP data you should have this erp lab. So, I have currently this latest version of ERP lab 8.30 here, you can check that.

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So, basically you everything should be added here, and it should that everything should be added into the path as well. So, which I have already added here in path; so, we will just start the eeglab and try to extract the data, extract the response.

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This is the home screen of eeg lab, once you open your file.

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If you want to import the data you can go to the file menu and based on the plugins you have installed, you will get different formats which you can acquire. If you are recorded using Neuroscan, there is a CNT file you can import. Currently we have used enobio which is from neuroscan file. So, we can either give nedf file or easy file, anything is fine. So, let us acquire the data using nedf file.

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- Plot ERP: "Plot > Ch	annel ERP > In scalp array*		

For that make sure that your MATLAB is at that particular level where your data lies. You can load the channel location, during the entire experiment subject who was lying without doing any kind of significant movement. We are not considering accelerometer channels, but we are loading the channel location. And you just press OK it will acquire your entire data, takes some time.

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Because, that particular experiment was repeated for 800 standard, 100 destructor and 100 target.

### (Refer Slide Time: 03:34)

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- Epoch data: "Tools > Extract epochs"			
- Flot ERF: "Plot > Channel ERF > In scalp array	r		

What is standard destructor and target? I told you standard small blue ball, target big blue ball and destructor is checkerboard, which distract you to from identifying target or big ball and subject was asked to click whenever that particular big ball came.

Now just to give a name let us say subject 1 I am writing here s1. Keep this name as short as possible because you are going to do so many operations. So, you can append if you are doing filtering underscore filt, if you are doing binbased epoch underscore binbased epoch, if you are doing artifact rejection underscore artifact rejection.

Ultimately it will go to a particular you know it will be a very long name instead just keep a small name here we will keep it subject 1 hit OK.

#### (Refer Slide Time: 04:19)

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So, that is no current dataset has been converted into s1. Now, there is a lot of information here, how many, what is first of all most important thing is what is the sampling rate? It is 500, how many events? So, it has detected 1102 event. Now, I told you that 800 standards or small ball, 100 target or big ball and 100 destructors or checkerboards are there. So, sum is 1000. Why this additional 102 events? So, I told you I asked subject to click. So, that also we have considered as event.

So, in response to 100 targets, subject has clicked maybe 102 times falsely clicked there. So, these are the total number of events and how many frames per epoch, and all will come to that as we will keep on going to process. Total epoch starts like currently you consider experimentation starts at 0 ends at 899.996 second. So, it is around 15-minute experiment. And that is why I took little bit time to import the data. So, once you import all these things you can check the data how it looks like or something, it is a row data. (Refer Slide Time: 05:36)

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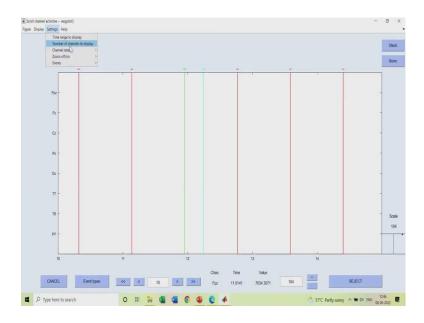
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So, you would not be able to make much sense out of it you need to do filtering. But, how to see the data? You can go to plot and channel data scroll I will do it again, Plot channel data scroll. Once you do that, you can see the screen in which 8 electrodes are there. Now, if you have understood the 10-20 system which was taught by Dr. Pandya properly you should know what is FPZ, F Z, C Z, P Z, O Z, T 7, T 8, P 7.

Now, if you can look at myself, I can explain that your FPZ is this particular point on your forehead, it is on midline. Followed by FZ which is there little bit above your

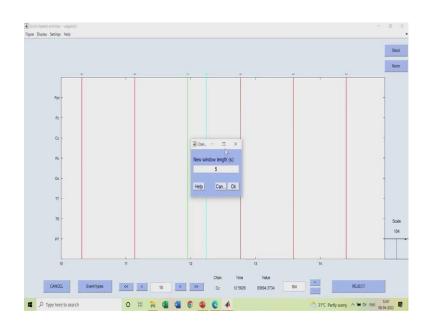
forehead in the mid line. Then CZ, PZ and OZ. Basically this thing covers your entire midline from your forehead to the backside of that. Now, this P 300 is this visual potential. So, it is more prominent in centro parietal or parietal occipital lobe. So, these three are the electrode of our interest we will see that. Now, if you see that, but you cannot see any kind of eeg and all right.

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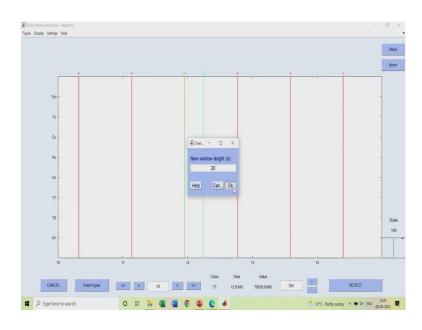


So, where are the responses? But here you can see the events 1, 2 here 4, 4 is your response with respect to 2 is your target. So, you can have an idea if I just maximize it.

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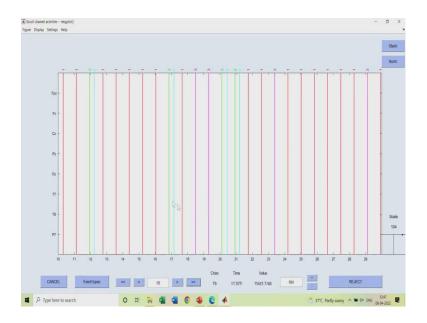


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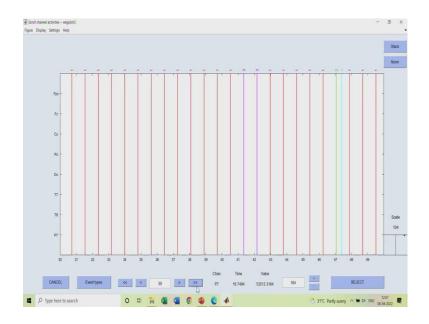
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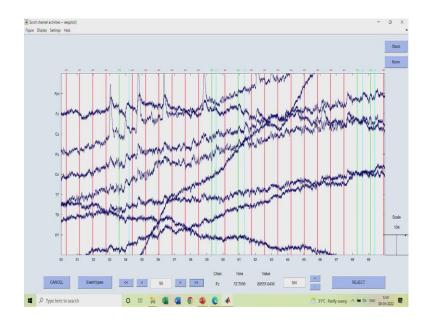
You can get all this thing. See one appears most number of times, the frequent stimuli which is your small ball 2 is your target. So, in response to that you can see this sand color four responses also there and 3 is your checkerboard. In response to that subject should not click.

## (Refer Slide Time: 07:27)



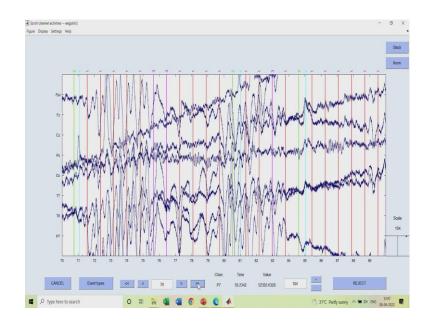
So, all these are just an event, but where is the data? We can see the event. But where is the data?

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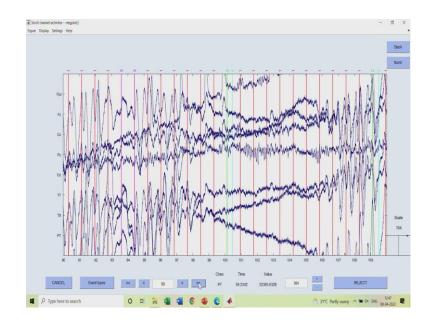
If you can remove the DC offset, you might be able to see the data. See all these brainwaves are dancing all around the screen.

# (Refer Slide Time: 07:38)

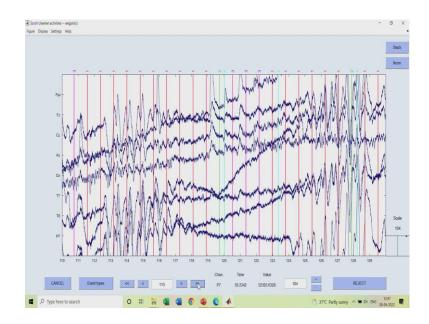


But the thing is it is not filtered.

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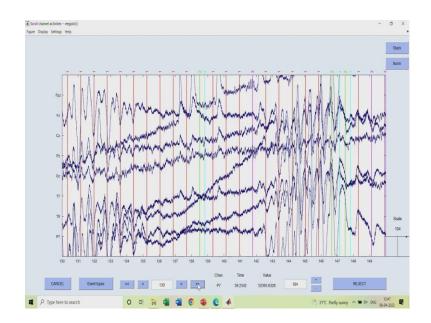


# (Refer Slide Time: 07:41)

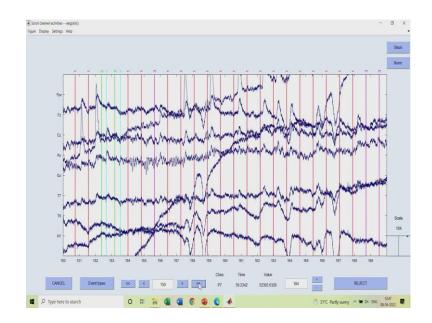


So, it has so much a non neural burst as well.

(Refer Slide Time: 07:44)

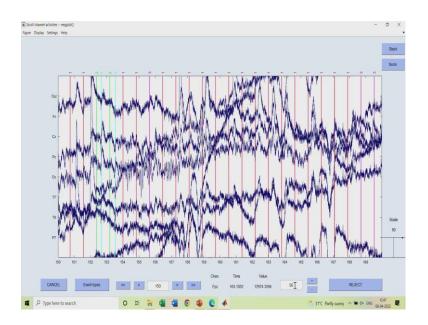


#### (Refer Slide Time: 07:46)



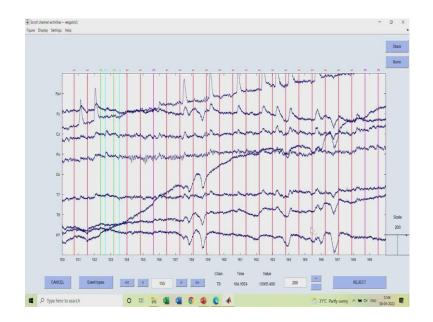
So, once we see the filtered data, we can make more sense out of it. But you can see here on one fiftieth second to one seventieth second this is the brain wave. Also, you can increase or decrease the sensitivity by changing this parameter.

(Refer Slide Time: 07:58)



See now it is all over.

#### (Refer Slide Time: 08:05)



If you want to still see the clean data, you can increase the scale of 200 you can see the again clean data. Also, you can see, this can be subjects blink because it is coming higher in the above electrode and here it is getting inverted. You can make more sense out of it once we do filtering, but this is basically how the data has been imported.

The main confirmation is your data is there which we have recorded, and your triggers are also there. So, this is important which you can see here also when you hover over this you can see the time and value, if you want to you know measure a particular value of electrode. So, we got this data as well as figure.

#### (Refer Slide Time: 08:46)

	*** ERPLAB x6.30 ***			
	Preprocess EEG >			
#1:s1	EventList			
	Assign bins (BINLISTER)			
	BDF Visualizer			
	Extract bin-based epochs			
Filename: none	EEG Channel operations			
	Filter & Frequency Tools	Filters for EEG data		
Channels per fram	Artifact detection in epoched data	Plot amplifude spectrum for EEG data		
	Summarize artifact detection	Filters for BIP data		
Frames per epoch	Compute averaged ERPs	Plot amplitude spectrum for ERP data		
traines per apoca	ERP Operations	Compute Evoked Power Spectrum from current ERPset		
	Plot ERP	EEG Linear detrend ERP Linear detrend		
Epochs	Export & Import ERP			
	Load existing ERPset(s)	EEG Polynomial detrend (continuous) (alpha version)		
Events	Clear ERPset(s)	1102		
	Save current ERPset			
	Save current ERPSet as			
Sampling rate (8)	Duplicate or rename current ERPset	500		
	ERP Measurement Tool			
Epoch start (sec)	ERP Viewer	0.000		
	Average across ERPsets (Grand Average)			
Epoch end (sec)	Datatype Transformations >	899,996		
phone and (sec)	Data Quality options	077.776		
	Utilities			
Reference	Settings >	unknown		
	Help			
Channel locations		No (label	s only)	
ICA weights		No		
sun verynus		av.		
Dataset size (Mp)		18.4		
Dataset Size (ND)		18.4		

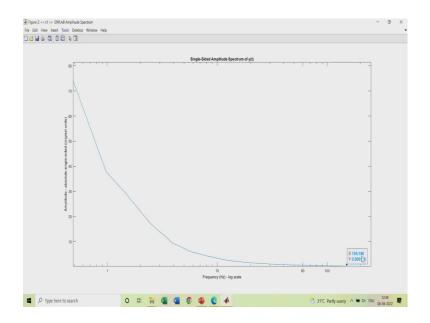
We will now quickly see how it looks like in frequency response. For that, you can go to filters and frequency tool and plot amplitude spectrum of eeg data.

(Refer Slide Time: 08:56)

	🐨 ERPLAB 830 + EEG Amplitude Spe 🛛 🗙	
#1:s1	Select channe(s)	
#1.01	Select bin(s)	
	Joest Longy	
Filename: none		
Channels per frame	Cinclude legend	
Frames per spoch	Finguescy range (F2 > F1) CANCEL F1 0 R2	
	F2 200 Hz ? BOT	
Epocha	F2 230 Hz PLOT	
Events	1102	
Sampling rate (Hz)	500	
Epoch start (sec)	0.000	
Epoch end (sec)	899.996	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	16.4	

Now, this data will give you an overall idea that whether you have a powerline interference or not and how many electrode. Currently let us consider all 8 electrodes combinedly, it will show you one frequency response.

#### (Refer Slide Time: 09:09)



Now, one more thing if you have noticed here it comes in x axis it is a frequency in log scale here amplitude. If you can see this here a lot of DC offset is there. So, which we can remove once we do filtering from 3 to 30 or 1 to 30. And there is a small tip here. So, that is around 150 which is nothing but a multiple of your power line interference which is 50 hertz. One more thing if you have noticed is when I have given the command, I have given the maximum frequency here 250.

Very important thing why I have given this 250 is because if you can see here the sampling rate is 500. So, as per Nyquist theorem if your sampling rate is fs, the maximum frequency which you can successfully obtain is 250. So, if I go here above 250 it shows error. So, it is a very basic thing for signal processing, but you should know that whatever your sampling frequency accordingly you should plot the spectrum. So, currently it is fine, spectrum looks good, but still a small this thing is there, but not that much hazardous.

In some of the cases around 50 hertz you will see a big spike, in that time you have to do notch filter. Here it is not required so we can directly go ahead with band pass filter.

#### (Refer Slide Time: 10:33)

(Expand tool choices via "File > Preferences")			
Change sampling rate			
Filter the data	Basic FIR filter (new, default)		
Re-reference the data Interpolate electrodes	Windowed sinc FIR II or Parks-McClellan (equiripple) FIR filter		
Inspect/reject data by eye Reject data using Clean Rawdata and ASR	Moving average FIR filter Basic FIR filter (legacy)		
Decompose data by ICA Inspect/label components by map Classify components using ICLabel Classify components using ICLabel			
Remove components from data Extract epochs		449999	
Locate dipoles using DIPFIT Remove epoch baseline		1	
Events		1102	
Sampling rate (Hr)		500	
Epoch start (sec)		0.000	
Epoch end (sec)		899.596	
Reference		unknown	
Channel locations		No (labels only)	
ICA weights		No	
Dataset size (Mb)		18.4	

How to do notch filter? How to do bandpass filter? We will see that in tools filter basic FIR filter.

(Refer Slide Time: 10:37)

#1:s1	
Filenane: none	
rilename: none	Lower edge of the frequency pass band (Hz) 49
Channels per frame	Higher edge of the frequency pass band (Hz) 51
	FIR Filter order (Mandatory even. Default is automatic*)
Frames per epoch	"See help text for a description of the default filter order heuristic. Manual definition is recommended.
Epochs	Notch filter the data instead of pass band
Events	Use minimum-phase converted causal filter (non-linearl; beta)
artered.	E Plot frequency response
Sampling rate (Hz)	Channel type(s)
	OR channel labels or indices
Epoch start (sec)	Help Cancel Ok
Epoch end (sec)	
Reference	unkaown
Channel locations	No (labels only)
ICA weights	No
Dataset size (Mb)	18.4

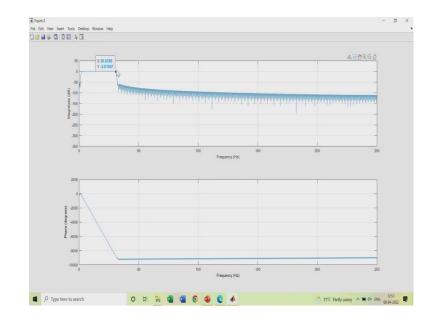
For the illustration purpose I am just selecting a basic FIR filter. If you want to remove 50 hertz noise you can check this option notch filter and you can give here 49 and 51. What it does is from 49 to 51, it notches the data, or you know it removes those particular frequencies which is basically of 50 hertz frequency. In that case this pass band will become a stop band, if I talk in actual sense, it will become a stop band. It will

stop the frequency from 49 to 51. Whereas here I will just give, we could not see any kind of power line interference in this data.

(Refer Slide Time: 11:14)

#1:s1		
	Filter the data pop_ergfitnew()	- 0 X
Filename: none	Lower edge of the frequency pass band (Hz)	3
Channels per frame	Higher edge of the frequency pass band (Hz)	30
	FIR Filter order (Mandatory even. Default is automatic*)	
Frames per epoch	*See help text for a description of the default filter order Manual definition is recommended.	heuristic.
Epochs	Notch filter the data instead of pass band	
Events	Use minimum-phase converted causal filter (non-linear	t; beta)
EVents	Plot frequency response	
Sampling rate (Hz)	Channel type(s)	
	OR channel labels or indices	
Epoch start (sec)	Help	Cancel Ok
Epoch end (sec)	nep	Cancer
Reference	unimos	n
Channel locations	No (la	bels only)
ICA weights	No	
Dataset size (Mb)	18.4	

So, what we can do is we can directly take 3 to 30 which lies in the range of brain ways. So, this particular data we are going to filter we want to see the frequency response.

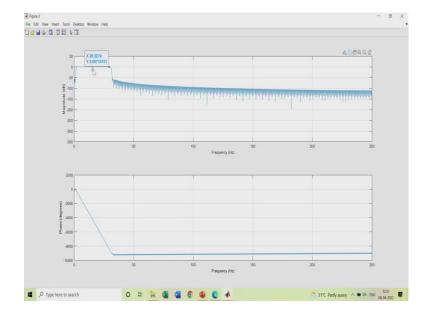


(Refer Slide Time: 11:28)

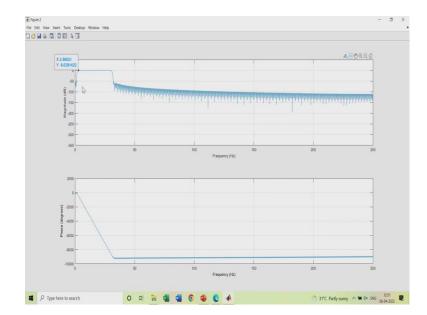
So, we will quickly see the frequency response, you can see first this. It shows your magnitude is 0. Now, we want to pass this frequency, why it is 0; this is in dB decibel. So, log 1 is 0 that is why, but it allows all this frequency. Now, it allows till which point

if you want to see you can put an indicator here and try to check. See till 30 it is showing some value.

(Refer Slide Time: 11:55)



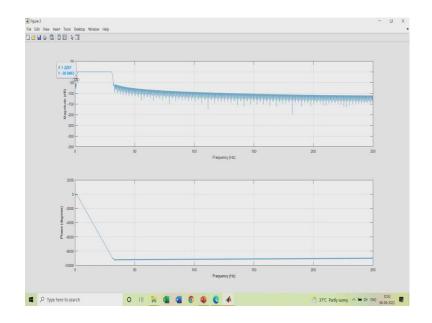
If you go above, see till 29 it is 0.007. So, it is almost it is allowing 29 till 31.



(Refer Slide Time: 12:02)

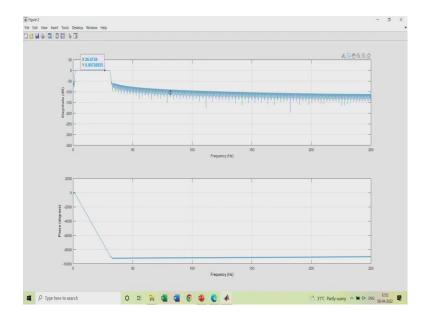
Also, from which point it has started allowing from 2.96 or something.

### (Refer Slide Time: 12:06)



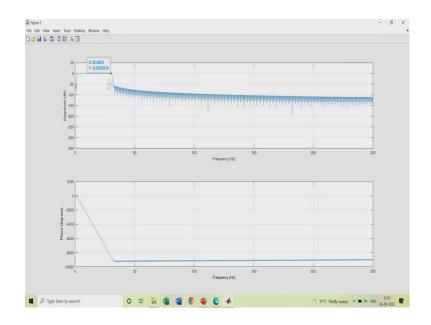
Beyond 2 it is not allowing it is a negative decibel value. So, magnitude will differ in the tense, drastically change. It will allow this frequency which is there in this pass band, and it will not allow all the other frequencies.

(Refer Slide Time: 12:20)



This all the ripples you can think you to remove if you want you can select a different form of filter and all.

(Refer Slide Time: 12:31)



But for us to for this particular application this thing looks fine. Also, you can see how the phase changes.

(Refer Slide Time: 12:37)

#1:s1			
Filename: none			
Channels per frame	Dataset info - pop_newset()	x	1
Frames per epoch	What do you want to do with the new dataset?		
Epochs	Name it: s1_fi		
Events		Browse	
Sampling rate (Hz)	Some changes have not been saved. What do you Overwrite it in memory (set=yes; unset=create a Save it as file:		
Epoch start (sec)			
Epoch end (sec)	Help	Cancel Of	
Reference		unknown	
Channel locations		No (labels only)	
ICA weights		No	
Dataset size (Mb)		18.4	

If you want, you can use a minimum phase filter as well. So, now, my data set will change. Earlier it was a raw data set now it is a filter data set. So, I will just write here filt. And then I have hit ok, now observe this 1 hashtag 1 s1this this is just a first data set. As soon as I give ok there, it will be updated.

(Refer Slide Time: 12:59)

#2: s1_filt	
Filename: none	
Channels per frame	8
Frames per spoch	449999
Epochs	1
Events	1102
Sampling rate (Hz)	500
Bpoch start (sec)	0.000
Epoch end (sec)	899.996
Reference	unknown.
Channel locations	No (labels only)
ICA weights	No
Dataset size (Mb)	18.4

So, now you have second data set which is already filtered.

(Refer Slide Time: 13:03)

	Detaset 1s1		
1	2: 6	 	
j.	filename: mone		
3	Thannels per frame	8	
	frames per epoch	449999	
0	lpochs	1	
3	Wests	1102	
	Sampling rate (Hz)	500	
1	spoch start (sec)	0.000	
1	spoch end (sec)	899.996	
1	leference	unknown	
0	hannel locations	No (labels only)	
	CA weights	No	
1	lataset size (Mb)	18.4	

You can observe all the data sets here, which will see at the last as well, but this is what your filtered data set now.

## (Refer Slide Time: 13:13)

	*** ERPLAB (6.30 ***		
	Preprocess EEG >		
#2:s1 filt	EventList >		
#2. 51_III	Assign bins (BINLISTER)		
	BDF Visualizer		
	Extract bin-based epochs		
Filename: none	EEG Channel operations		
	Filter & Frequency Tools	Filters for EEG data	
Channels per fram	Antifact detection in epoched data	Piot amplitude spectrum for EEG data	
CONTRACT AND	Summarize artifact detection	Fittes NF ERP data	
	Compute averaged ERPs	Pice amplitude spectrum for EBP data	
Frames per epoch	ERP Operations	Compute Evoked Power Spectrum from current ERPset	
	Plot ERP 3	EEG Linear detrend	
Epochs	Export & Import ERP	ERP Linear detrend	
	Load existing ERPset(s)	EEG Polynomial detrend (continuous) (alpha version)	
Events	Clear ERPset(s)	1102	
Events	Save current ERPset	1102	
	Save current ERPset as		
Sampling rate (E)	Duplicate or rename current ERPset	500	
	ERP Measurement Tool		
Epoch start (sec)	ERP Viewer	0.000	
	Average across ERPsets (Grand Average)		
	Datatype Transformations	899,996	
Epoch end (sec)	Data Quality options	899.996	
	Utilities >		
Reference	Settings >	unknown	
	Help		
Channel locations		No (labels only)	
		(survey out)	
ICA weights		No	
ren receptes			
Dataset size (Mb)		18.4	
range are liev			

How to check that whether the data set has changed or not? Again, you go to and check the amplitude spectrum.

(Refer Slide Time: 13:16)

e Study Datasets Help ERPLAB ERPliets	🖀 ERPLAB 8:30 + EEG Amplitude Spe. 🦟 🔲 🗙	
	Select channel(s)	
#2:s1_filt	18 Bronze	
	Select bin(s)	
Filename: none		
Channels per frame	🖸 include legend	
	Frequency range (F2 > F1) CANCEL	
Frames per epoch	FT 0 Hz ?	
Epochs	F2 250 H2 PLOT	
Events	1102	
Sampling rate (Br)	500	
Bpoch start (sec)	0.000	
Spoch end (sec)	899.596	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	18.4	
	7 G G O G O A O 37	iC Partly sunny \land 🖮 🕸 E

For all eight channels you check the amplitude spectrum.

### (Refer Slide Time: 13:21)

#2: s1_filt	Single-Sided Amplitude Spectrum of y(1)	
Filename: none		
Channels per frame		
Frames per epoch		
Epochs	us 4 . Option	
Events		
Sampling rate (Ez)		
Epoch start (sec)	1 10 60 100	
Epoch end (sec)	Frequency (Hz) - log scale	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	Ко	
Dataset size (Mb)	18.4	

And you can see now some mountain kind of shape is there, whatever the DC offset of 70 magnitude or something has been removed and which should be removed because you want to have an idea about what exactly is happening underlying the brain and which is like underlying the skull which is 3 to 30 years or something. So, you are getting this kind of amplitude spectrum of your data.

(Refer Slide Time: 13:52)

	*** ERPLAB x6.30 ***		
	Preprocess EEG >>		
#2:s1 filt	EventList	Create EEG EVENTUST	
#2: \$1_III	Assign bins (BINLISTER)	Import EEG/eVENTUST from text file	
	BDF Visualizer	Export EEG EVENTUST to text file	
	Extract bin-based epochs	Shuffle events/bins/samples	
Filenane: none	EEG Channel operations	Summarize current EEG event codes (output at command window)	
	Filter & Frequency Tools 3	Export reaction times to text >	
Channels per fram	Artifact detection in epoched data	Import ERP EVENTLIST from text file	
time per tra	Summarize artifact detection	Export ERP EVENTUST to text file	
	Compute averaged ERPs	Transfer eventinfo to EEG.event (optional)	
Frames per epoch	ERP Operations	483333	
	Plot ERP >		
Epochs	Export & Import ERP >	1	
	Load existing ERPset(s)		
Events	Clear ERPset(s)	1102	
areas a	Save current ERPset		
	Save current ERPset as		
Sampling rate (E)	Duplicate or rename current ERPset	500	
	ERP Measurement Tool		
Epoch start (sec)	ERP Viewer	0.000	
	Average across ERPsets (Grand Average)		
Epoch end (sec)	Datatype Transformations	899.996	
phone one incol	Data Quality options	11.77	
	Utilities		
Reference	Settings > Help >	unknown	
	Hep		
Channel locations		No (labels only)	
ICA weights		No	
Dataset size (Mb)		16.4	
Darager Size (MD)		10.4	

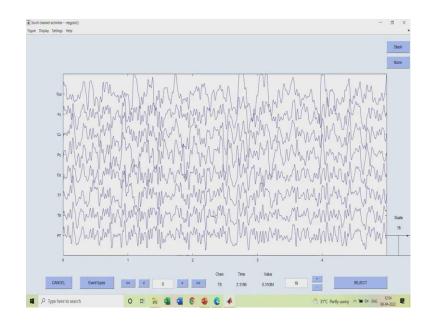
Next step is to give an information to your system about events. When particular event happened, what how many standards, how many target, how many destructor to identify

that there is something called event list. You have to create the event list to tell your computer that at this particular time this standard come, at this particular time this distractor come. How do you do that?

Changel data (scroll) Chankel spectra and maps	
Chanied spectra and maps	
Channel properties	
Channel ERP image	
Channel ERPs	
ERP map series	
Component activations (scroll)	
Component spectra and maps	
Component maps	
Component properties	
Component ERP image	
Component ERPs	
Sum/Compare comp. ERPs	
Time-frequency transforms	
Events	
Sampling rate (Hz)	
Epoch start (sec)	
Epoch end (sec)	
Reference	
Channel locations	
ICA weights	
ICA weights	

(Refer Slide Time: 14:09)

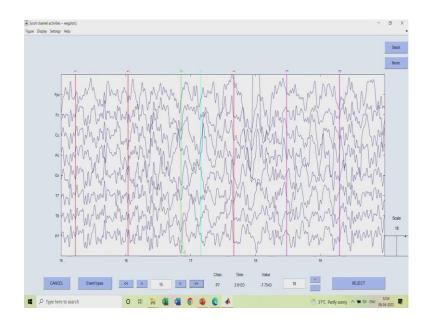
Like if you have seen the channel data scroll now it will look much better first of all.



(Refer Slide Time: 14:12)

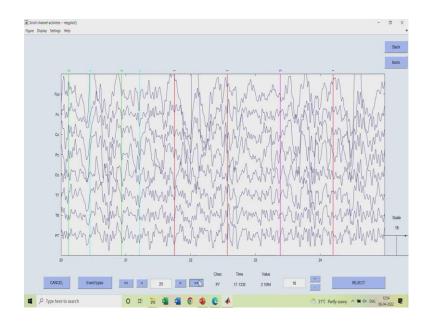
Because we have filtered the data it will look much better than previously.

# (Refer Slide Time: 14:16)

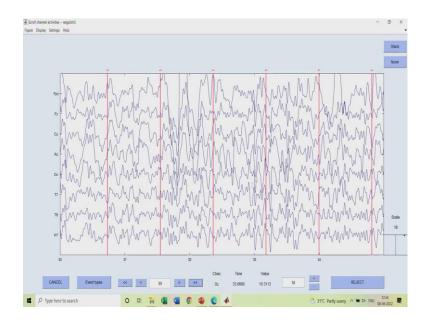


See it looks like a clean eeg data and also triggers are there.

(Refer Slide Time: 14:20)

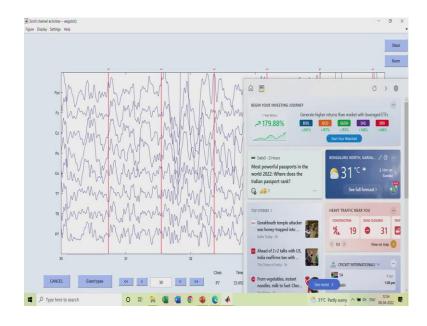


## (Refer Slide Time: 14:21)



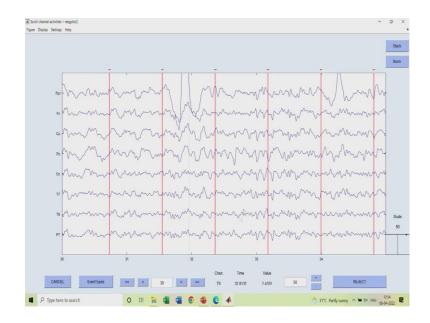
But it looks much better than what you have seen before it is not interfering to each other.

(Refer Slide Time: 14:26)



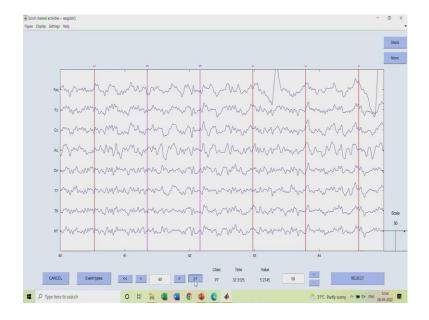
Also, you see the scale has been reduced drastically. Earlier it was some 500 or something, now it is 200 or something and now it is just 80.

(Refer Slide Time: 14:34)

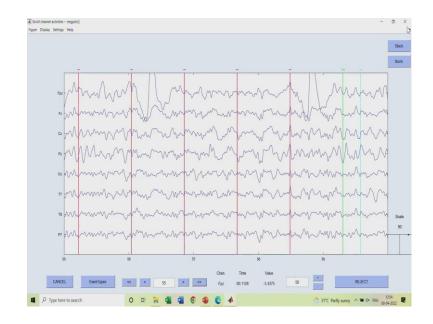


If I further go down, see you can see the clean eeg looking really good right.

(Refer Slide Time: 14:39)



(Refer Slide Time: 14:41)



So, this is the filtered data, and this is the you know advantage of filtering the data.

(Refer Slide Time: 14:51)

	Preprinter EEG		
		Contraction of the second se	
#2: s1_filt	Elementant Assign bits (BML/5707)	Contro 100 (VENTUST from last file	
	BOF Visualizer	Export ETL EVENTEET was seen the	
	Esthart bin based epochs	Duffe even/bristansie	
Filename: mmm	EIG Owner operations	Summarius cament DEC event codes couput at command windowi	
ATTACTOR ( 1994)	Titter & Prequency Tools	Experies reactions to use to load	
	Artifact iteraction of agenched data	Report Reaction Long to Link. 1	
Channels per from	Sumption activat detection	Expert (AP (2014)22) there are the	
	Computer averaged DMN	Transfer avantified to EDL avant implicitati	
Trases per spoch	ERP Operations	Tanker Parented to Locarier Indicate	
	Pol (3P		
Sporths .	Export & Import ERP	(a)	
adaines.	Load existing (RPsets)		
	Clear Difference		
Events	Save colour LIDert	3102	
	Save current SWPset as		
Rangiling vale int	Deplicate or sename carson LEPser	300	
A CONTRACT OF	ERP Measurement Total		
	CAST Viscour-		
Spoch start (sed)	Average across TRParts (Grand Average)	6.004	
	Datatype Transformations		
Aprich west (sec)	Data Quality options	899,994	
	Otilites		
Selectors	Settings >	uniterios	
	Harty H		
Channel Incations		No (labels only)	
SCA weights		84	
Dataset size ORA		28.4	

So, let us say this is a filtered data, next step is to give computer a sense about the triggers or timing information you can do it by creating event list. How will you do that?

(Refer Slide Time: 14:56)

#2: s1_filt	
Filename: none	■ BPU& Wenny - D X
Channels per frame	Some or all of your events contain a test-based event label, and not a
Frames per epoch	numeric event code.
Epochs	ERPLAB must have a numeric code for every event (a text table can also be present). For labels such as "SM", you can automatically create an equivalent numeric event code (e.g., 14) by checking the box labeled
Events	<sup>2</sup> "Dreate numeric equivalents of nonnumeric event codes when possible" when creating the EventList.
Sampling rate (B2)	For labels that cannot be automated just prefixed to the CRESPT, or for ambiguous cases (e.g., when you have both 'ST4' and 'Rt4'), you can flexibly construments wrinking where Achieved button at EVENTUST
Epoch start (sec)	GUL
Epoch end (sec)	Confige
Reference	minon
Channel locations	No (labels only)
ICA weights	80
Dataset size (Mb)	18.4

Go to create event list.

(Refer Slide Time: 14:57)

	Cotonal	
#2: s1_filt	Export EventLast to text the	Binne
Filename: none	Boundary and alphanument events	
	Add code -99 for "Eboundary" events (strongly recom	mended)
Channels per frame	Convert string code	boundary
Frames per epoch	to numeric code	*
Epochs	Create numeric equivalents of nonnumeric event codes	s when possible
Events	(e.g., CS12/C becomes 12)	
Sampling rate (Hz)	Warn ne if an EVENTLIST is aready attached	to mis-dataset
Epoch start (sec)	CANCEL ? ADAPAC	
Epoch end (sec)	899.996	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	18.4	

(Refer Slide Time: 15:00)

	Currently edited exerticodes 1 "SOOBa" 1 "SOOBa"	Event into A Event Code (number)	4	
#2: s1_filt	2 *1000m* 2 *1000m* 3 *54* 3 *54*	Event Label	cist	Current
	new line	(string, max 16 char)	uce	Dere
Filename: none		Bin Info (optional) Bin number	4	
Channels per frame		Bin description	cick	Updah
Frames per epoch		Boundary and alphanument even	nts	
Epochs		Add code -99 for 'boundary'	events (strongly recommended)	
Events		Convert	To label 'boundary' and con	22
EVENUS		Eliminate nonnumeric informa	don (e.g., 'S12 becomes 12)	
Sampling rate (Bz)		Write resulting EVENTUST to		
Epoch start (sec)		Current dataset		
about cours (could		Ted File	none	
Epoch end (sec)		Matlab workspace (as EVEN)	UST vanable)	
Reference	Equation List	Warn me if an EVENTUST is	aiready attached to this dataset	
Channel locations	File: D'WATLAB_Deno/Sam	Por plotting and other EEGLAB t		
Champer rocacions		Transfer EVENTLIST int	to EEG event	
ICA weights	Load list Save list Save list	Cearfie	7	APPLY
			· .	

And you have to go to advance option, and you need to change this. This was some previous experiment. So, I will just remove this. You need to add your own understanding, or you need to tell.

(Refer Slide Time: 15:13)

Port Ladi     Port Ladi       Part Ladi     Port Ladi       Port Ladi	#2:s1 filt	1 "standard" 1 "standar	ed* A Event Code (number)	1	Curre
Flictanet: som     Bit number     1       Channel: per frame     Bit decryfor     danter:       Frame per spoch     Bit decryfor     danter:       Egocks     Domet     bit bit bondry act componential (sig. 317) termes 10)       Brenzis     Domet     bit bit bondry act componential (sig. 317) termes 10)       Begoch start: (se)     We wurdt pESTLIST bit     Domet				standard	
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Fizees per spoch boundary and aplanements cents  Bouchs  Detection  Detection	Channels per frame		Bin description		Upr
Epochs  Epochs E	Frames per epoch			events	
Events USBnue sources etomator e _ 3.92 Secons (2) Sampling sate (83)  Book start (sec)  Duret dates  proce	Epochs		Add code -99 for 'bound	ary'Cevents (strongly recommended)	
Sampling rate (B1)         Write resulting DESTLIST to           Egock statt (sec)         Union down of the same state	Duarte		Convert	to label 'boundary' and c	ode
Rpoch start (sec)			Eliminate nonnumenc inf	ormation (e.g., 'S12' becomes 12)	
Led fie note	Sampling rate (B2)			1	
Epoch: end (sec)	Epoch start (sec)		Ted Fie	none	
	Epoch end (sec)				
Bederence Equation List	Reference	Equation List			
Channel locations File: DWUTUAE_DemoSample DWARARA M Channel locations DWUTUAE_DemoSample DWARARA M	Channel locations	File: D1847	LAB_DEMO/Sample Ustal Aprila to		
TOX weights	ICA weights	Load list Save list Save			APPLY
Dataset size (MD)	Dataset size (Mb)				APPLI

So, event code 1 stands for standard, again it will form a beam number 1, I will name it std ok or we can write standard also standard. As soon as you give all this thing you have to update that particular line.

(Refer Slide Time: 15:28)

#2:s1 filt	Currently odded eventcodes	Event Code (number)	2	Current E
	Dev line	Event Label (string, max 16 char)	target	
Filename: none		Bin Info (optional) Bin number	2	Deiete
Channels per frame		Bin description	target	uprate
Frames per epoch		Boundary and alphanumeric	exects	
Epochs			ary'Devents (strongly recommended)	
Events		Convert	to later boundary and o	ođe
Sampling rate (Hz)		Einimale notinumeric into Write resulting EVENTUST to	ormation (e.g., 'S12 becomes 12)	
Epoch start (sec)		Current dataset		
Epoch end (sec)		Tet Fie	none	
		Matlab workspace (as EV	ENILUSI variable) T is arready attached to this dataset	
Reference	Equation List	For piciting and other EEGU	48 functions	
Channel locations	U MAI LAB_DEMOSampe Data Aserca to	Transfer EVENTUST		
ICA weights	Load list Save list Save list as Clear file	CLOSE	?	APPLY
Dataset size (Nb)				

Again go 2, 2 was target we have seen in response to that subject was praising the thing, again 2 is target. Update the line.

(Refer Slide Time: 15:42)

Filenane: none E	] Corvert	events (strongly recommended) to label 'boundary' and code	Dees	
Flinnmeis par frame Finnes par spoch Egonha Events Sempling rate (Hz)	Bin number Bin description Joundary and aphaeumenic ene JAdd code -49 for "boundary" Convert	distractor ets levents (strongly recommended) to later boundary and code	Updat	
Channels per frame Frames per epoch Roots Boests Boests	Bin description loandary and alphanumenic ene   Add code +09 for 'boundary'C   Convert	distractor ets levents (strongly recommended) to later boundary and code		
Frames per epoch and a second a	ioundary and apharumenc eve Add code -00 for 'boundary'C Convert	nts levents (strongly recommended) to later 'boundary and core		
Epochs Ements Sampling rate (Mr)	Add code -09 for 'boundary'	events (strongly recommended) to label 'boundary' and code		
Rpocha Events Sampling tete (Rt)	] Corvert	to label 'boundary' and code		
Seens Regiling mate (Hm)				
Sampling rate (Kr)	Elminate nonsumeric informa	dan in a 1217 has seen 171		
		Eliminate nonumenc information (e.g., '\$12 becomes 12)		
	Write resulting EVENTUST to			
	Current dataset			
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Epoch end (sec)	Matlab workspace (as EVENT	(LIST vanable)		
	Warn me if an EVENTUST is	aready attached to this dataset		
File: D 11411.45 Deno/Sande Data ABRa to	For plotting and other EEGLA8 functions			
Channel locations	Transfer EVENTLIST into to EEG event			
CA velights Load list Save list Save list as Clear file				
	CLOSE	?	PPLY	
utaset size (MD)				

Same thing you do for distractor as well.

(Refer Slide Time: 15:54)

#2:s1 filt	Currently edited eventcodes	"standard" A	Event Info Event Code (number)	3	Current E
	840-7278		Event Label (string, max 16 char)	distractor	
Filename: none			Bin title (optional) Bin number	3	Delete
Channels per frame		ERPLA8: update last line?	- 0 X	distractor	Update
Frames per epoch		You modified the line #	2, but you did not update if	1	
Epochs		Go back & ("gdate	Continue & do not update	ents (strongly recommended	
			Ljuarven	to label 'boundary' and	I code
Events			Eliminate nonnumeric informat	on (e.g., 'S12' becomes 12)	
Sampling rate (Er)			Write resulting EVENTLIST to		
Epoch start (sec)			Current dataset		1
Epoch end (sec)			Ted File Matlab workspace (as EVENTL	none	H.
		~	Wan me if an EVENTUST is a		
Reference	Equation List				
Channel locations	Fie :	D IMATLAB_Demo/Sample Data ABRIa to	For plotting and other EEGLAB functions		
ICA weights	Load list Sav	e list Save fist as Clear file			
Dataset size (Mb)			CLOSE	?	APPLY

Once you do that event list will be automatically created which we can further see. Now, if you forget to update the line this pop up will come that you would update it. You have written it here, but you have not update. You can go back and again update it. So, all these things have been this is I need to again update the second line because it was updated in the previous line.

(Refer Slide Time: 16:19)

2 "distraction" 3 "distraction" 2 "farged" 2 "farget" new line	Event Label		Current		
	(string, max 16 char)	target			
	Bin Info (optional)		Delete		
	Bin number	2			
	Bin description	target	Updat		
	Boundary and alphanument even	Boundary and apharument events			
	Add code -99 for 'boundary'	undary Devents (strongly recommended)			
	Convert	to label 'boundary' and code			
	Eliminate nonnumeric informa	Eliminate nomumeric information (e.g., S12 becomes 12)			
	Write resulting EVENTLIST to	Write resulting EVENTUST to			
	Durrent dataset				
	Ted Fie	none			
	Matlab workspace (as EVENT	rust vanable)			
English	Warn me if an EVENTUST is	aready attached to this dataset			
	For plotting and other EEGLAB	For plotting and other EEGLAB functions			
	Transfer EVENTLIST inf	Transfer EVENTLIST into to EEG event			
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	CLOSE		ru -		
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I will update it here again, 2 was target, again 2 was target and again I have to update the line. So, you can see all these three events are there. Currently I am not interested in you know response or pressing the button.

## (Refer Slide Time: 16:38)

	Currently edited eventcodes	"standard"	Event Info  Event Code (number)	1	1
#2:s1_filt	3 "distrator" 3 2 "target" 2 Dew line	"distractor" "target"	Event Label (string, max 16 char)	standard	Current Ex
Filename: none			Bin Info (optional)		Delete L
Channels per frame		Save List of changes	Bin number - D	1 X standard	Updafe L
Frames per epoch		You have not save			
Bpochs		What would you like Seve and Continue	e to do? Save As Cancel	strongly recommended	
Events		M2	Eliminate nonnumeric inform	-	coce
Sampling rate (Bz)			Write resulting EVENTUST to		
Epoch start (sec)			Current dataset	none	Ros
Epoch end (sec)			Ted File Matlab workspace (as EVEN		
Reference	Equation List		Warn me if an EVENTUST is	aready affacted to this dataset	
Channel locations	Fie:	D 1847LA8_Dem/Sample Data	ABRIa to For plotting and other EEGLAB		
ICA weights	Load list Sa	ve list Save fst as Clear file			
Dataset size (Mb)			CLOSE	?	APPLY

So, I will just apply this to event list, it will say and then it will ask to quote the labels whatever has given.

(Refer Slide Time: 16:42)

lot Study Datasets Help ERPLAB ERPorts	■ EMPLAB 830 · Modify EEG □ X	
#2:s1_filt	Villamoy  File EEG creat lato al be constalled by life EEGRATUST contributos	
Filename: none	Into to be used as Event Type	
Channels per frame		
Frames per epoch	Code Laters	
Epochs	O Bn Labes	
Events	O Bin Index	
Sampling rate (Hz)	internove som capturest event codes	
Epoch start (sec)	CANCEL MILLY	
Epoch end (sec)	859.396	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	18.4	
here to search O H	🐂 🍓 🥶 🔕 🕲 📣 🔿 ar	C Partly sunny 🧄 🕯 ENG

So, these labels have been generated through the system 1, 2, 3, 4 what you have seen in the when we were scrolling through the data.

(Refer Slide Time: 16:51)

#2: s1_filt		
Filename: none		
Channels per frame	Dataset into - pop_newset()     -	×
Frames per spoch	What do you want to do with the new dataset?	
Epochs	Name it:         s1_fit_elist         Edit description           Save it as file:         Browse	
Events	Some changes have not been saved. What do you want to do with the old dataset?	
Sampling rate (Bz)	Overwrite it in memory (set+yes; unset+create a new dataset)     Save it as file:     Browse	
Epoch start (sec)		
Epoch end (sec)	Help Cancel OK	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	18.4	

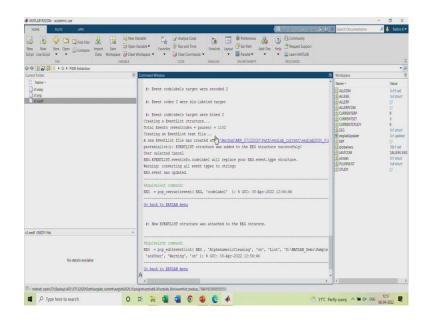
So, it will again it will ask to change the name. So, you just append elist to that. So, it will create one more data set.

(Refer Slide Time: 16:58)

#3: s1_filt_elist		
Filename: none		
Channels per frame	8	
Frames per epoch	449999	
Bpochs	1	
Events	1102	
Sampling rate (Hr)	500	
Epoch start (sec)	0.000	
Epoch end (sec)	899,996	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	20.9	

So, this 2 has been shifted to 3. First, we tick the data filtered it and generated elist. How that elist is generated? What is there in elist?

(Refer Slide Time: 17:07)



You can go to here command window and here you can see a new event list was created at this particular place. Go there, open that particular file click on that. It will show you the generated event list yeah.

(Refer Slide Time: 17:22)

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	17 /		
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So, you can see that when it is generated, using which version of ERP program it is generated?

(Refer Slide Time: 17:29)

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Also, you can see there are 800 standards, 100 targets, 100 distractors.

(Refer Slide Time: 17:35)

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	35 6 0	1	standard	13.5860	816.00	0.0	000000	STUDY	11
	36 7 0		standard	14,4020	816.00	0.0	000000		
	37 8 0	1	standard	15.2200	818.00	0.0	000000		
	38 9 0	1	standard	16,0340	814.00	0.0	000000		
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Now, when it is generated? What particular time? What is the difference between two particular events? All this thing you can check here. Now, generally 800 was given now it is slightly more 18. So, difference is 18 millisecond 1 8 millisecond is jitter. Here it is 288 because it is we have not given the name, but it is fourth number event code is 4 which is a click of the mouse that is why it is less.

(Refer Slide Time: 17:57)

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	53 2			standard	25.8320	816.00	0.0	00000	<b>STUDY</b>	
	53 2		1	standard	26.6500	818.00	0.0	00000		
	56 2		1	standard	20.6500	816.00	0.0	00000		
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Otherwise generally it is around 816, 888, 816.

(Refer Slide Time: 17:59)

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Some delay will come in order to give the trigger, but that can be compensated later. So, this is elist has already been generated and you can see that total 1102 events are there out of which our interest is only for this 1000 event. 102 keypress we are not considering much, but here if you can see this is the elist.

(Refer Slide Time: 18:28)

*** ERPLAB (6.30 ***		
Preprocess EEG >		
EventList		
Assign bins (BINUSTER)		
BDF Visualizer		
Extract bin-based epochs		
EEG Channel operations		
Filter & Frequency Tools		
Artifact detection in epoched data		
Summarize artifact detection	.*	
Compute averaged ERPs		
ERP Operations	449999	
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Export & Import ERP	1	
Load existing ERPset(s)		
Clear ERPset(s)		
Save current ERPset	1102	
Save current ERPset as		
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Next step is to generate the bin-based epoch based on this elist.

(Refer Slide Time: 18:32)

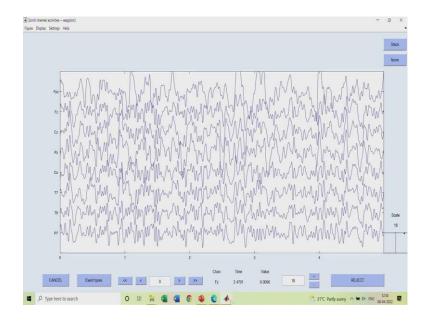
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Filename: mone	rässeller Connector. Onzer O Past O Coston (ms) start stop	
Channels per frame	Pre Ownoe	
Frames per epoch		
Epochs	CANCEL ? RUN	
Events	1102	
Sampling rate (Ez)	500	
<pre>Bpoch start (sec)</pre>	0.000	
Bpoch end (sec)	859.996	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	Ко	
Dataset size (Mb)	20.9	
e here to search O H	🐂 🍓 😨 🔮 😨 🔺 👘 🔿 зис	Partly sunny \land 🖮 🕸 ENG

So, I will generate the binbased epoch. Here the important thing is when a particular event happens how much amount of time before that you want to consider because there is something called baseline. I will show it to you in graph itself.

(Refer Slide Time: 18:47)

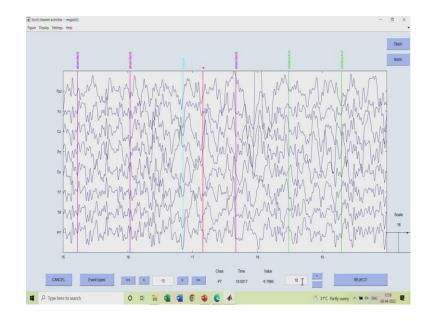
Channel locations > Channel data (scroll)		
Channel spect, and maps		-
Channel properties		
Channel ERP image		
Channel ERPs		
ERP map serves		
Component activations (scroli)		
Component spectra and maps		
Component maps		
Component properties		
Component ERP image		
Component ERPs >		
Sum/Compare comp. ERPs		
Time-frequency transforms		
Events		
Sampling rate (Hz)		
Epoch start (sec)		
Epoch end (sec)		
Reference		
Channel locations	nlyi	
ICA weights		

(Refer Slide Time: 18:51)



So, if you can see here channel data scroll, another change which has happened is.

(Refer Slide Time: 18:54)



You can see now the name of the particular event has started coming. Standard, target the fourth number we have not given is the response.

(Refer Slide Time: 19:09)



So, for me to record or you know make the sense out of it, it is important that I will consider not only after onset that is called post stimulus data, but pre stimulus as well, that before you have given this particular sound what was the trend? So, what I will do is exactly before this I will take some amount of data and then after. So, that will give me an idea that how much change this particular event has posed when this particular event happened. So, pre stimulus some time and post stimulus at the time of your interest we need to consider. Now this ITI is 800 milliseconds.

So, post stimulus we should take anything which is less than 800 milliseconds, it is like a common sense and pre stimulus we need to take some data. Generally, thumb rule is if you are taking 500 millisecond this time this side post stimulus take 10 percent of that pre stimulus. So, -50 to 500 or -100 also depends on how you know your baseline. And this all are like as I mentioned your frequency for filters you can take 1 5 to 30 1 to 30 or 3 to 30. Similarly, your baseline you can take -50 to 500, -100 to 500 or even -50 to 700, -100 to 700.

So, it is like a problem of choices, you can only identify what is the optimal values of your parameters by doing it. So, the idea of showing all these thing is to make you people understand that what is baseline, what is called pre stimulus interval, what is called post stimulus thing and why baseline is important?

(Refer Slide Time: 20:46)

	*** EIPLAB v6.30 ***		
	Preprocess EEG 3		
10 4 Ch 11 4	Eventiat 2		
#3: s1_filt_elist	Assign bins (BINUSTER)		
	BDF Visualizer		
	Extract bin-based epochs		
Filename: none	EEG Channel operations		
	Filter & Frequency Tools		
Channels per fran	Anifact detection in epoched data	1	
conneto her rim	Summarize artiflact detection		
	Compute averaged ERPs		
Frames per epoch	ERP Operations	449999	
	Plot ERP >		
Epochs	Export & Import ERP	1	
	Load existing ERPset(s)		
Events	Clear ERPsetial	1102	
EVENUS	Save current ERPset	1102	
	Save current ERPSet as		
Sampling rate (Hi	Duplicate or resame current ERPset	500	
	ERP Measurement Tool		
Epoch start (sec)	ERP Viewer	0.000	
	Average across ERPsets (Grand Average)		
	Datatype Transformations		
Epoch end (sec)	Data Quality options	899.996	
	Utilities >		
Reference	Settings >	unknown	
	Help >		
Channel locations		No (labels only)	
		and consists and the	
ICA weights		No	
and analysis			
Dataset size (Mb)		20.9	
re to search	O 🖽 🐂 🦉 📲 (		👌 31°C Partly sunny \land 🖮 🕸 ENG

So, now and all this thing matters when you are generating bin-based epoch.

#### (Refer Slide Time: 20:48)

Study Datasets Help ERPLAB ERPorts	ERPLAB 830 - EXTRACT BINEP 🗆 X
	Bin-based epoch time range (ms)
#3: s1_filt_elist	-100 500) Her
Filename: mone	Baseline Correction O Inone O Post O Coston (ms) start stop
Channels per frame	Pro Othos
Frames per epoch	
Epochs	CANCEL ? RAIL
Events	1102
Sampling rate (Hz)	500
Epoch start (sec)	0.000
Bpoch end (sec)	899.596
Reference	unknown
Channel locations	No (labels only)
ICA weights	No
Dataset size (Mb)	20.9

So, now you will generate a binbased epoch as I mentioned we will let us take -100 to 500 milliseconds. It is written already in millisecond baseline correction we are giving pre stimulus baseline correction, just run the command it will generate the bin-based epoch.

(Refer Slide Time: 21:05)

#3: s1_filt_elist				
Filename: none				
Channels per frame	Dataset info - pop_newset()		- 0 X	
Frames per epoch	What do you want to do with the n	ew dataset?		
Epochs	Name it: Save it as file:	s1_filt_elist_be	Edit description Browse	
Events	Some changes have not been save	d Mhat de veu waat te de wit		
Sampling rate (Ez)	Overwrite it in memory (set=ye	es; unset=create a new dataset)		
Epoch start (sec)	Save it as file:		Browse	
Epoch end (sec)	Help		Cancel Ok	
Reference		unknown		
Channel locations		No (labels	only)	
ICA weights		No		
Dataset size (Mb)		20.9		

#### (Refer Slide Time: 21:08)

#4: s1_filt_elist_be	
Filename: mone	
Channels per frame	8
Frames per epoch	300
Epocha	1000
Events	1093
Sampling rate (Hz)	500
Epoch start (sec)	-0.100
Epoch end (sec)	0.490
Reference	unimown
Channel locations	No (labels only)
ICA weights	No
Dataset size (Mb)	15.2

So, now, if you see here, you can see here the thing has come is epochs 1000 because we have generated bin-based epoch. And this 1000 means 800, 100, 100 also frames per epoch. Now we have gone for -100 to 500, 600 milliseconds whereas, sampling rate is 500 hertz. So, each epoch will take 600 milliseconds. 600 millisecond is nothing but 300 samples, that is why frames per epoch comes at 300, total epochs are 1000, sampling rate is 500. Epoch starts at -100 millisecond or -0.1 second. Epochs end at 0.498 second which is around 498 milliseconds.

Reference we are not given that is fine because we already filled reference externally. Now this is your binbased epoch is done.

#### (Refer Slide Time: 22:04)

	*** ERPLAB vE30 *** Preprocess EEG >>			
	EventList >			
#4: s1_filt_elist	Assign bins (BINLISTER)			
	BDF Visualizer			
	Extract bin-based epochs			
Filename: none	EEG Channel operations			
	Filter & Frequency Tools			
	Artifact detection in epoched data	Simple voltage threshold		
Channels per fran	Summarize artifact detection	Mdling window peak-to-peak threshold		
	Compute averaged ERPs	Blink rejection (a/pha version)		
Frames per epoch	ERP Operations	Step-like artifacts	10	
	Plot ERP	Sample to sample voltage threshold		
Epochs	Export & Import ERP	Rate of change -time derivative- (alpha version)	100	
	Load existing ERPset(s)	Blocking & flat line		
	Clear ERPset(s)	Clear artifact detection marks on EEG		
Events	Save current ERPset	Synchronize artifact info in EEG and EVENTUST	193	
	Save current ERPset as	Post Artifact Detection Epoch Interpolation		
Sampling rate (E)	Duplicate or rename current ERPset	1	500	
	ERP Measurement Tool			
Epoch start (sec)	ERP Viewer		-0.100	
apres cours (ove)	Average across ERPsets (Grand Average)			
	Datatype Transformations			
Epoch end (sec)	Data Quality options		0.498	
	Utilities			
Reference	Settings >		inknown	
	Help			
Channel locations		1	(o (labels only)	
ICA weights		1	to	
Dataset size (Mb)			15.2	

Next step is to artifact rejection.

(Refer Slide Time: 22:08)

Hereord part of production (production (productity production (production	let Study Datasets Help ERPLAB ERPsets	🖌 Extreme Values - 🗆 X	
Hastificients   Filences:::::::::::::::::::::::::::::::::::		Test period (start end) (ms) Voltage limits(aV) (e.g100 100)	
Filiance: zone   Channel i per frame   Frames per spoch   Spochas   Spocha state (nec)   Roch end (nec)   R	#4: s1_filt_elist_be		
Fileace: and   Channel per frame   Frames per epoch   Spota   Boota   Boota state (nec)   Epoch end (nec)   E		Carrels	
Chanail jer: frame Frames per spoch Spochs Senses Sampling rate: (Rer) Expone more Spoch stat: (Ser) Expone more Spoch stat: (Ser) Expone more Submer Statemer Sub	Filename: none		
Frame per apos Bpoch start (sec) Bpoch start (sec	Channels per frame		
Restance (Sec) Restance (Sec)	Frames per epoch	Available Channels Broase	
Rents sequing rate (82) good etait (sec) Root eta (sec) Root eta (sec) Sequence Cases locations Sequence Seq	Paralla .	Mark Flag (flag 1 is reserved)	
Sequileg rate (Ref Rpoch start (seq) Epoch end (sec) ACEPT Reference Channel locations No tabels only Do weights Sec	agouna -	8 7 6 5 4 3 2 1	
Sempling mate (Hz) Rgoch start (Hz) Rgoch end (Hzc) Reference channel locations Channel locations Sempling mate (Hz) Reference Sempling mate (Hz) Sempling ma	Events		
Rpoch start (sec)     0.499       Reference     sklown       Channel locations     No (labels only)       10k weights     No	Sampling rate (Hz)	Copen viewer	
Reference ukbown. Charsel locations No (Labels only) 10% weights No	Epoch start (sec)	CARCEL Revet ? ACCEPT	
Channel locations No (labels only) ICR weights No	Epoch end (sec)	0.498	
10k weights No	Reference	unknown	
	Channel locations	No (labels only)	
Darlanet size (Mb) 15.2	ICA weights	Но	
	Dataset size (Mb)	15.2	

So, you can use a simple voltage threshold here as you can see. And here again you need to change the interval -100 to 498 in all channels you want to see and this value again. I talk about parameters about you know filters, cut off frequency, etcetera. I talk about parameters, pre stimulus interval, add one more into that voltage threshold or voltage limit. You can give -100 to plus 100. In some of their cases you can give -50 to plus 50 up to you.

### (Refer Slide Time: 22:43)

Plot Study Datasets Help ERPLAB ERPsets	Select Channel(s) -	u x u x
	1 = Fgz 2 = Fz	^ ( -100 100)
#4: s1_filt_elist_be	3+02 4+92 5+02 6+17	00
Filename: nome	7 = 15 8 = P7	-
Channels per frame		
Frames per epoch		Bronze
Bpochs		
Events		2 1
Sampling rate (Er)		
Bpoch start (sec)		ACCEPT
Epoch end (sec)		
Reference		<u>.</u>
Channel locations	CANCEL	Nok Marage
ICA weights	No	
Dataset size (Mb)	15.2	
	* 9 9 0 1	🐴 31°C Partly sunny \land 🖮 🕸

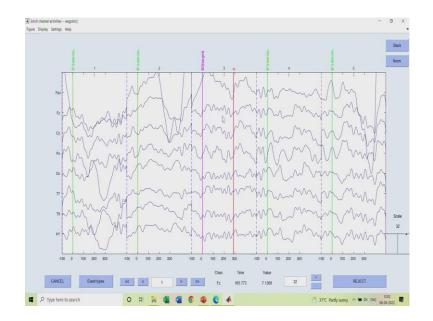
You can select all the available channels from here already selected. So, you can see here; and after your artifact rejection if you want to see the viewer that out of all the data what are the data has been removed, you can see that.

8 200 1009	
200	
200	
200	
200	
200	
200	
200	
200	
1000	
1000	
1093	
500	
-0.100	
0.498	
unknown	
No (labels only)	
No.	
15.2	
	-6.100 0.499 makanom No (Labels only) No

(Refer Slide Time: 22:59)

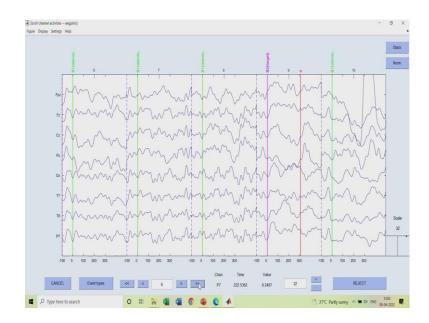
Before that, after every step it is important to see the channel data scroll what change it has enforced.

#### (Refer Slide Time: 23:02)

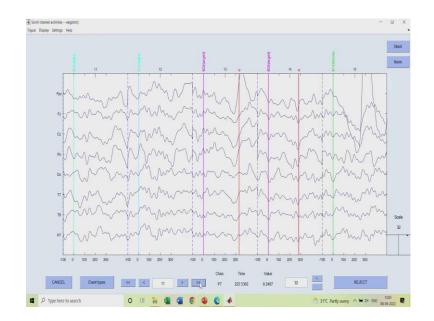


So, before that you have seen only target and all the data now bin is created also this dash line has come which we wanted. I told you we are interested in 100 milli second prior to stimulus which is happening. I told you we are interested in 500 milliseconds after the stimulus which might be somewhere here. Same thing you can see here -100 and somewhere around 500 here again -100, 500.

(Refer Slide Time: 23:36)



## (Refer Slide Time: 23:38)



So, time axis, which was continuous and going like a 10, 15, 100, 200 has been limited now to -100 to 500 because that is the only thing which matters. So, let us see epochs are created.

(Refer Slide Time: 23:45)

	*** ERPLAB VE.30 ***			
	Preprocess EEG >			
#4:s1 filt elist	EventList	-		
#4. 51_IIIL_CIISI	Assign bins (BINLISTER)			
	8DF Visualizer			
	Extract bin-based epochs			
Filename: none	EEG Channel operations			
	Filter & Frequency Tools			
Channels per fran	Artifact detection in epoched data	Simple voltage threshold		
	Summarize artifact detection	Moling window peak-to-peak threshold		
	Compute averaged ERPs	Blink rejection (alpha version)		
Frames per epoch	ERP Operations >	Step-like artiflacts	10	
	Plot ERP	Sample to sample voltage threshold		
Epochs	Export & Import ERP	Rate of change -time derivative- (alpha version)	00	
	Load existing ERPset(s)	Blocking & flat line		
Events	Clear ERPset(s)	Clear artifact detection marks on EEG	93	
	Save current ERPset	Synchronize artifact info in EEG and EVENTUST		
	Save current ERPset as	Post Artifact Detection Epoch Interpolation		
Sampling rate (H)	Duplicate or retaine current ERPset		500	
	ERP Measurement Tool			
Epoch start (sec)-	Et9 Viewer		-0.100	
	Average across ERPsets (Grand Average)			
Epoch end (sec)	Datatype Transformations		0.498	
phone and incol	Data Quality options			
	Utilities			
Reference	Settings > Help >	1 7	unknown	
	Hep			
Channel locations		1	No (labels only)	
ICA weights			No	
Dataset size (Mb)			15.2	
Decesec alle (ND)			1416	

We can quickly see the artifact do the artifact rejection.

## (Refer Slide Time: 23:49)

Rot Study Datasets Help ERPLAB ERPlats	🕢 Extreme Nalues - 🗆 X	
	Test period (start end) (ns) Voltage limb()/V) (e.g100 100)	
#4: s1_filt_elist_be	-100 498 -100 100	
	Clamela	
Filename: none		
Channels per frame		
Frames per spoch	Analabie Charrente Broane	
	Mark Flag (flag 1 s reserved)	
Bpochs	8 7 6 5 4 3 2 t	
Events		
Sampling rate (Hz)	Open vewer	
Bpoch start (sec)	CARCEL RIMH ? ACL,PT	
Epoch end (sec)	0.496	
Reference	unimoven	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	15.2	
here to search O Hi	🐂 🧃 🧃 📀 🤹 💽 📣 🔗 31°C Parti	ly sunny \land 🖮 🗱 ENG

Go here, -100 to 498, -100 to 100 is fine

(Refer Slide Time: 23:57)

#4:s1_filt_elist_be     #60       #1:lense: zone     #60       Channels per finme     #60       Frames per epoch     #80       Spoch statt (sec)     #80       Dansel locations     #80       10. wights     \$6	Plot Study Datasets Help ERPLAB ERPsets	Select Charmel(s) - X X
Finance: none     Finance: none       Channels per frame     Finance: none       Frames per spoth     Image: none       Ryoch statt (sec)     Image: non	#4:s1_filt_elist_be	2+Ft (*******) 3+Ct 4+Ft 5+Ct 00
Frames per spoch Rpochs Events Sampling same (III) Rpoch start (Inet) Rpoch start (Inet) Rpoch start (Inet) Reference Channel locations (IX) weights Market (INET) Reference Re	Filename: mone	7= 18
Roch start (sec) Roch start (	Channels per frame	
Erents Sequence (sec) Roch etal (sec)	Frames per epoch	Brone
Prents despilang sarte (tat) Rjoch statt (seci) Roch eta (seci) Reference Cource on one one one one one one one one one	Epochs	
Rook statt (sec) Rook end (sec) Reference Channel locations ISK wights Bo	Events	2 1
Room state (sec) Root end (sec) Reference Channel locations ICA weights Bo	Sampling rate (Er)	
Reference CMCR OK CMCR	Epoch start (sec)	ADDEPT
Channel locations or terretor mage 103 weights 80	Epoch end (sec)	
Channel locations an university and the second seco	Reference	
	Channel locations	
Dataset size (Mb) 15.2	ICA weights	Жо
	Dataset size (Mb)	15.2

That is a standard range of artifact rejection. Select all this thing and just hit the accept button.

#### (Refer Slide Time: 24:01)

So, again as I mentioned it will keep on adding all these different naming conventions. It will get suffixed because why this all is important? Because if I just read the name, I can get an idea the subject row data was taken, filtering was done, elist was created, bin based epoch generated and artifact rejection is done.

(Refer Slide Time: 24:24)

#5: s1_filt_elist_be_ar		
Filename: mone		
Channels per frame	8	
Frames per epoch	300	
Epochs	1000	
Events	1093	
Sampling rate (Hz)	500	
<pre>Bpoch start (sec)</pre>	-0.100	
Epoch end (sec)	0.498	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	15.3	

So, it is an important nomenclature and makes things much easier.

(Refer Slide Time: 24:29)

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start	15   creation da			12.55-1	14				- 1	ALLEEG	INO SDUCT
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	25								100	STUDY	
	26 # item bepoc	a ecode	label		cnset (sec)		diff (msec)	dura	b_fla (t		
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	4								>		
	Command Window								۲		
	Bin #(%) Sccepte	d ∉(%) rejected	# F2	# 173	1 E4	1 ES	1 26	\$ 87	1 28		
Lnedf (NEDF File)	1 700( 87.5)	100(12.5)	0	0	1 23	1 23	0 20	8 21	1 10		
	2 90( 90.0)	10( 10.0)	0	0			0	ő			
	3 93( 93.0)	7( 7.0)	0	0		0	ò	ő	0		
No details available	Total 883( 88.3)	117(11.7)	0	0	0	0	0	8	0		
									10		
	∫t Done. What's next	2							~		
	¢								>	<	
							UTF-8	0	ain text file		Ln 20 Col 1

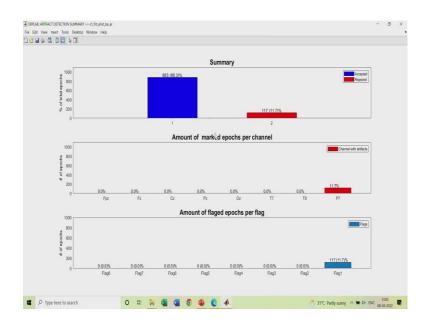
So, if you see here this should summarize your overall artifact rejection. Out of 800 standards, 700 were accepted, out of 100 targets, 90 were accepted, out of 100 distractor 93 were accepted. All over 1000 events 883 were accepted which is good enough to average it out and make the sense. So, now, we have got this artifact rejection stuff.

(Refer Slide Time: 24:57)

	Preprocess EEG >	
	EventList 2	
#5: s1_filt_elist	Asign bins (BINLISTER)	
	BDF Visualizer	
	Extract bin-based epochs	
Filename: none	EEG Channel operations	
	Filter & Frequency Tools	
Channels per frag	Artifact detection in epoched data	8
channels per fran	Summarize artifact detection Summariz	artifacts in one value
		artifacts in a table
Frames per epoch		a Jacts in a graphic 300
	Plot ERP Summariz	artifacts in a table
Epochs	Export & Import ERP	1000
	Load existing ERPset(s)	
Events	Clear ERPset(s)	1093
Evenus	Save current ERPset	1073
	Save current ERPset as	
Sampling rate (H)	Duplicate or rename current ERPset	500
	ERP Measurement Tool	
Epoch start (sec)	ERP. Viewer	-0.100
	Average across ERPsets (Grand Average)	
Epoch end (sec)	Datatype Transformations	0.498
phone con (acc)	Data Quality options	**174
	Utilities >	
Reference	Settings > Help >	unknown
Channel locations		No (labels only)
ICA weights		No
Dataset size (Mb)		15.3

You can also see go here and summarize the artifact rejection in table, graphic. You can put it in one value also, you can see all this thing.

#### (Refer Slide Time: 25:09)



Like, I have just asked to summarize the artifact rejection in graphic. So, whatever we have seen in command window you can see in a very nice way that 883 were accepted, this were rejected. Out of all electrodes which channels was having artifact and what is the flag of that. So, all these things you can analyze and check.

(Refer Slide Time: 25:29)

Denet tot Denet tot Denet Sot () (1) #501 Denet Sot () (1) Denet Sot ()	
Select multiple datasets Filename: none	
Channels per frame	8
Frames per epoch	300
Epochs	1000
Events	1093
Sampling rate (Er)	500
Spoch start (sec)	-0.100
Spoch end (sec)	0.499
Reference	unknown
Channel locations	No (labels only)
TCA weights	No
Dataset size (Mb)	15.3

Thing is now we have got the data filtered, elist generated, bin-based epoch generated and artifact were rejected.

(Refer Slide Time: 25:35)

	*** EFR.AB x630 ***		
	Preprocess EEG >		
#5:s1 filt elist	EventList >		
#0: \$1_THL_eHSI	Assign bins (BINLISTER)		
	8DF Visualizer		
	Extract bin-based epochs		
Filename: none	EEG Channel operations		
	Filter & Frequency Tools		
Channels per fram	Artifact detection in epoched data	8	
commers per fran	Summarize artifact detection >	•	
	Compute averaged EVPs		
Frames per epoch	ERP Operations	300	
	Plot ERP 3		
Epochs	Export & Import ERP	1000	
	Load existing ERPset(s)		
1000000	Clear ERPsetisi		
Events	Save current ERPset	1093	
	Save current ERPset as		
Sampling rate (E)	Duplicate or rename current ERPset	500	
	ERP Measurement Tool		
Epoch start (sec)	ERP Viewer	-0.100	
apres cours (see)	Average across ERPsets (Grand Average)		
	Datatype Transformations		
Epoch end (sec)	Data Quality options	0.498	
	Utilities >		
Reference	Settings >	unknown	
	Help >		
Channel locations		No (labels only)	
Commer 100801005		no frances our l	
		No	
ICA weights			

So, we can we are good to go with the average. So, this step is important what it does is it converts your eeg into ERPs.

(Refer Slide Time: 25:44)

	EEG Dataset(s) Index
5:s1 filt elist be ar	5
	Epochs to include in ERP Average
	O Include ALL epochs (gnore artifact detectors)
lename: none	
	<ul> <li>Exclude epochs marked during artifact detection (highly recommended)</li> </ul>
annels per frame	O Include ONLY epochs marited with artifact rejection (be cautious!)
	O Include ONLY the following epochs :
ames per epoch	(epoch indices or filename ( td) ) Epoch Subset Acoustant
ochs	
ents	
	Use letane Vew fe coat of
mpling rate (B2)	
	Use epoch indices cisar action Save Listan
och start (sec)	Exclude epochs that contain either "boundary" or invalid events (highly recommend
	Data Quality Quantification
och end (sec)	On - default parameters
	On - custon parameters Bir DD Aptons. ?
ference	O No Data Quality measures
annel locations	
dianta avedeavais	Power Spectra Create a file with Tapering function - e.g. 'tameng' [-200
A weights	Total Power Spectrum ?
	Evoked Pover Spectrum ?
taset size (Mb)	
	CANCEL ? RIN

Here all these options you can select that you have to include all the epochs you have to exclude the epochs which has been rejected during artifact detection. You can do both. Also, what you can do is you can select this data quality parameters. If you want, you can also generate power spectrum and evoke power spectrum. For now, I will just consider with the default option and I will just trying to generate the ERP. Also, you can see the data set number is 5.

There are multiple data sets 1, 2, 3, 4 but what we want to include is data set 5 which has been gone through all the set of operations which is our best fit to neural data set. So, I will just run this.

(Refer Slide Time: 26:36)

let Study Datasets Help ERPLAB ERPlats	🐨 ERPLAB 8.30 - Save Erpset GUI - 🗆 X	
	You are creating a new erpset	
#5: s1_filt_elist_be_ar	What would you like to do with IP	
Filename: mone	O diversitie in memory	
	Create a new expect # 1     same as filename	
Channels per frame	eptane s1_edraclad	
Frames per spoth	Optional	
Epochs	Save ESP as     Browse	
Events	st_edracted ep	
Sampling rate (Ez)	sate as optime	
Epoch start (sec)	Cancel	
Epoch end (sec)	0.498	
Reference	unknown	
Channel locations	No (labels only)	
ICA weights	No	
Dataset size (Mb)	15.3	

You have to name the ERP, I will just name s1 underscore extracted. So, you can save the ERP as well.

(Refer Slide Time: 26:53)

Flienne: noe  Cannols per frame frame per spoch frame (spoch start (sec) frame (spoch start	#5:s1_filt_elist_be_ar	
Channels per frame     6       Framers per spoch     300       Rpochs     1000       Remers     1001       Remers     1001       Remers     500       Rpoch start (sec)     -6-100       Reference     uninom       Channel locations     500 tables only	#v. al_int_enat_be_at	
Frames per spoch     300       Rpochs     100       Pretts     193       Smpling sate (m)     500       Rpoch state (me)     -4-100       Rpoch state (me)     0.440       Reference     unknom       Channel locations     50 (Labels mly)       JON weights     30	Filename: none	
Bpochs     1000       Bronts     1000       Bronts     1000       Broch start (sec)     500       Bpoch start (sec)     -4.100       Bpoch start (sec)     6.484       Beferator     uninom       Channel Joccione     500 (Labris only)       JO, wights     50	Channels per frame	8
Prents     1951       Begling parse (B)     500       Egoch start (sec)     -6.100       Egoch start (sec)     -6.484       Egoch start (sec)     0.484       Edenson     unknom,       Chansel locations     So (tabels only)       100, wights     So	Frames per epoch	300
Begiling inter (fm)     500       Bpoch start (enc)     -0.100       Bpoch start (enc)     0.490       Bpoch end (sec)     0.490       Bedemone     unknom       Channel locations     So: (tablis only)       200, wights     So:	Epochs	1000
Epoch start (sec)     -6.100       Epoch start (sec)     8.400       Reference     unknom       Channel locations     80 (labels ml)p       100, weights     80	Events	1093
Bpoh md (sec) 0.489 Reference unknow Chansel locations So (labels only) 108 weights So	Sampling rate (Br)	500
Reference unitions Channel locations No (labels only) 10% weights No	Epoch start (sec)	-0.100
Channel locations So (Labels only) 203. weights So	Epoch end (sec)	0.490
201, wights No	Reference	unknown
	Channel locations	No (labels only)
Dataset size (MD) 15.3	ICM weights	No
	Dataset size (Mn)	15.3

So, now, you see earlier data sets were there. Now, ERP set you can see one ERP which is generated. So, once ERP is generated next step is to analyze it and check what are the data lies there and all.

	*** ERPLAB v8.30 *** Preprocess EEG		
#5: s1_filt_elist	EventList Assign bins (BINLISTER) BDF Visualizer	>	
	Extract bin-based epochs		
Filename: none	EEG Channel operations		
	Filter & Frequency Tools		
Channels per fram	Artifact detection in epoched data Summarize artifact detection		8
	Compute averaged ERPs		
Frames per epoch	ERP Operations		300
	Plot ERP	Plot ERP waveforms	
Epochs	Export & Import ERP	Plot ERP scalp maps	1000
Events	Load existing ERPset(s) Clear ERPset(s) Save current ERPset	Print plotted figure(s) to a file Edit ERP channel location table Load ERP channel location file	1993
	Save current ERPset as	Load ERP channel location into using EEGLA8	
Sampling rate (H)	Duplicate or rename current ERPset	Clear ERP channel location info	500
Epoch start (sec)-	ERP Measurement Tool ERP Viewer	Close all ERPLAB figures	-0.100
	Average across ERPsets (Grand Average)		
Epoch end (sec)	Datatype Transformations Data Quality options Utilities		0.498
Reference	Settings Help		unknown
Channel locations			No (labels only)
ICA weights			No

(Refer Slide Time: 27:06)

So, you can plot the ERPs using ERP lab plot ERP function.

(Refer Slide Time: 27:12)

#5:s1 filt elist be ar	ERPLAB 830 - ERP Plotting GUI - s1_extracted - X
	Bins to plot Channels to plot
	show number of channel instead of label
Filename: none	al tens Browne al channels Browne
	10 14
Channels per frame	Scares E-SPSET
-	Scales EXPSET include MGFP from these channels some
Frames per epoch	-100.0 456.0 mm box
Epochs	Baseline Correction (only for pixting purpose)
	Y range (min max, e.g10 20) Okone O Post Ocustors (min max, in ms)
Events	-37.3935-25.7448 Y tota Legend pos @ Pre O Whole -100.0 0
	Autor Vicks onton
Sampling rate (Ez)	Syte
	Background Topographic . W 0.05
Epoch start (sec)	store standard error x 0 White V maximum figure h 0.05
and a state state	transparenty 0
Epoch end (sec)	Set Font Sae Set frame(s) Channel(s) Legend(s) Aris tick labels Row(s) Column(s)
Reference	positive is up UNE SPEC 10 12 10 10 3 3
Channel locations	CANCEL Close Figures RESET ? Scalp map PLOT
ICA weights	No
Dataset size (Mb)	15.3

Yeah, here you can see a lot of options. And it is very easy first is there are 3 bins which we have created. It will ask what are the bins you want to plot, you want to only plot standard, you want to only plot distractor you can do that. You want a legend or not. So, that is what this guy tells ok this particular dialog box the scales. The scales you want from minus 100 to 498. In time domain what are the range you want.

Further you can say you want a specific scale or not. Also, SEMs very important it shows the trend you are going you are doing almost 100 to 200 or even for standard 800 epochs. During each epoch it gives different response. So, what is the variability amongst the epochs? So, the trend and variabilities will be given using this option. So, what you can do is, here you can enable it, or we will enable it later I will show it to you. Some of the neurophysiologists or clinicians prefer to see the negative up when they are specifically checking for negative potential.

So, they just have to see positive like upside peak and make a sense out of it. In that time, you can go here do negative up positive up anything is fine. Also, you want to see all channels or a particular channel. Now, I have mentioned that this is a visual P 300 experiment where all the data and all the dominancy can be seen in the centro parietal occipital lobe, which is my 3, 4 and 5 channel. So, we will come to that, but first let us see all the channels also you can go here and go for a topographic view. So, it will give you a better indication of how the data looks like.

(Refer Slide Time: 29:06)

#5: s1_filt_elist_be_ar	
Filename: none	
Channels per frame	€ Look up channel locations? - □ X
Frames per epoch	Only channel labels are present currently, but some of these labels have known
Epochs	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 buttor (Read location) in the following gui. If you do not know, just press DK.
Events	
Sampling rate (Hr)	use BESA file for 4-shel dipfit spherical model   D1BackupIAEP_07122020/Pathleeglab_current/eeglab2020_0/plugins
Epoch start (sec)	
Epoch end (sec)	Help Cancel Q
Reference	unknown
Channel locations	No (labels only)
ICA weights	Xo
Dataset size (Mb)	15.3

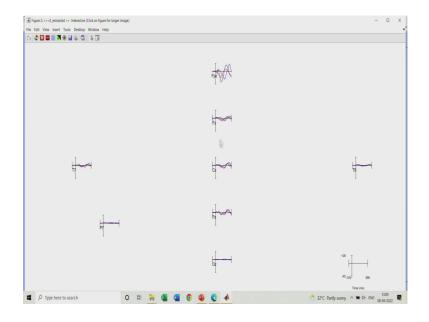
So, let us just quickly plot it first and it will ask for channel location.

(Refer Slide Time: 29:11)

	Edit channel info pop_chanedit()		- 🗆 X	
#5: s1_filt_elist_be_	e Channel information ("field_name"):			
	Channel label ('label')	Fpz	Opt. head center	
Filename: none	Polar angle ("theta")	0	Rotate axis	
	Polar radius ("radius")	0.50669	Transform axes	
Channels per frame	Cartesian X ("X")	84 9812		
	Cartesian Y ("Y")	0	Xyz → polar & sph.	
Frames per epoch	Cartesian Z ("Z")	-1.786	Sph> polar & xyz	
	Spherical horiz, angle ("sph_theta")	0	Polar -> sph. & xyz	
Epochs	Spherical azimuth angle ("sph_phi")	-1.204		
	Spherical radius ("sph_radius")	85	Set head radius	
Events	Channel type		Set channel types	
Sampling rate (Ez)	Reference		Set reference	
Sampling fate (HI)	Index in backup 'urchanlocs' structure	1		
Epoch start (sec)	Channel in data array (set=yes)			
Epoch end (sec)	Delete chan Cha	nnel number (of 8)		
byous can jacot	Insert chan << <		>> Append chan	
Reference			Append chan	
Channel locations	Plot 2-D Plot radius (0.2-1, []=auto	) Nose alon	g +X Plot 3-D (xyz)	
	Read locations Read locs help	Look up locs Save	(as .ced) Save (other types)	
ICA weights	Overwrite Original Channels	Look up locs Save	(as .ced) Save (other types)	
Dataset size (Mb)				
	Help		Cancel Ok	

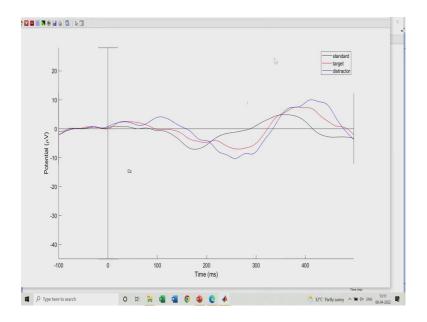
If you have deep pit inside, you can just give the channel location and you can see the data.

(Refer Slide Time: 29:13)



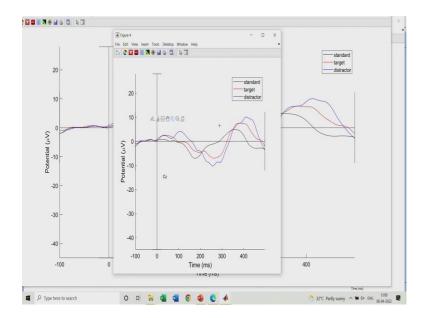
So, F PZ, F Z, C Z, P Z, O Z, T 7, T 8 is on your temporal lobe and P 7 here. Here is the scale which you can use, but this is entire midline on your head. Why did I do that? I just want to show you the response according.

(Refer Slide Time: 29:38)



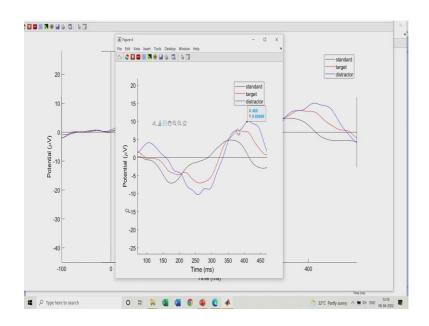
If you want to see any particular thing you can click on that. You will see only that particular electrode.

(Refer Slide Time: 29:44)



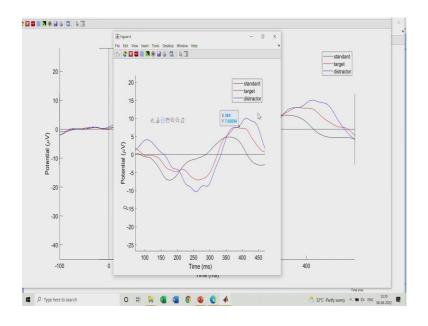
You can stretch this; it will give you a better result. Now this experiment is around known as P 300 ok. P 300 means some positive peak around 300 milliseconds, so with respect to your target and distractor. So, you can see here, this is black color line is your standard as it is shown here. Further red color line is your target, target means a big ball. So, when you click on the big ball, and it comes around if you see here around 350 or somewhere you can see the peak which is significantly higher than your standard. Same for distractor it is even higher.

#### (Refer Slide Time: 30:23)



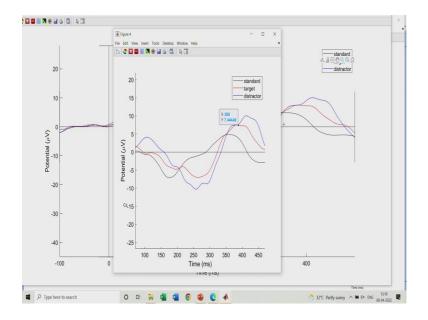
So, you can put a indicator here and see when actually the peak occurs. So, for distractor, it occurs around 400 milli second.

(Refer Slide Time: 30:35)



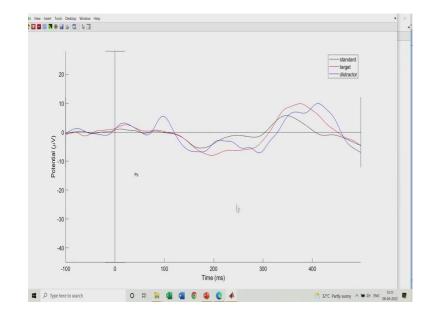
Whereas I can consider this peak its 390 or something. I am talking about this red color trace not the blue one.

(Refer Slide Time: 30:42)



So, if you can see here, it is around 388 also you can see there is the plateau. It results due to multiple peaks because all this standard and target basically target known as P 3 b working memory and this distractor known as a P 3 a component or P 3 100 which is for attention. So, this comes on because of a several neurophysiological processes happening underlying your scalp.

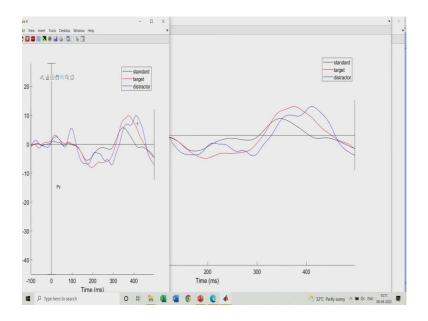
So, that is why sometimes you get multiple peaks sometimes you get plateau as a result of multiple process, eliciting due to your event triggers. So, this particular thing you can see here is nothing but your C's response from your C Z electrode.



(Refer Slide Time: 31:35)

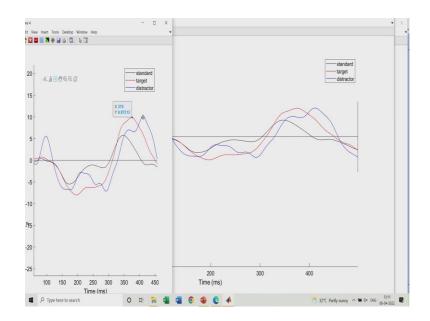
And you can see a very nice P 300 here, same thing as I mentioned that you will get a better response in C Z, P Z, O Z. So, here if I open the P Z electrode you can also see the similar form of response.

(Refer Slide Time: 31:39)



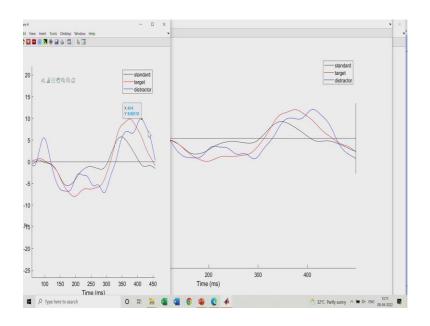
And it also peaks around 300 to 400 milliseconds.

(Refer Slide Time: 31:43)



Here if you see this target trace elicits way much before in terms of time 378 millisecond.

(Refer Slide Time: 31:53)



Whereas this distractor peaks at 414 milli second. So, it is an objective measure for some of the subjects it might be earlier, for some other subjects it might come slightly delayed, but name P 300 suggests that there should be some positivity after 300 milli second. It comes generally in 300 and 400 millisecond. It is a topographic view now as we have seen and analyzed we are sure that the better results are there in C Z and P Z. Now C Z and P Z is nothing but your third and fourth electrode.

(Refer Slide Time: 32:23)

	*** ERPLAB x6.30 ***			
	Preprocess EEG >>			
#5: s1 filt elist	EventList			
#J. SI_IIIL_elisi	Assign bins (BINUSTER)			
	8DF Visualizer			
	Extract bin-based epochs			
Filename: none	EEG Channel operations			
	Filter & Frequency Tools >			
Channels per fram	Artifact detection in epoched data		8	
Commerce Sar Fran	Summarize artifact detection >			
	Compute averaged ERPs			
Frames per epoch	ERP Operations >		300	
	Plot ERP >	Riot ERP waveforms		
Epochs	Export & Import ERP	Pliot ERP scalp maps	1000	
	Load existing ERPset(s)	Print plotted figure(s) to a file		
Events	Clear ERPset(s)	Edit ERP channel location table	1093	
areas a	Save current ERPset	Load ERP channel location file		
	Save current ERPset as	Load ERP channel location info using EEGLA8		
Sampling rate (H)	Duplicate or rename current ERPset	Clear ERP channel location info	500	
	ERP Measurement Tool	Close all ERPLAB figures		
Epoch start (sec)	ERP Viewer		-0.100	
	Average across ERPsets (Grand Average)			
Epoch end (sec)	Datatype Transformations		0.498	
phoen can incol	Data Quality options		v.179	
	Utilities			
Reference	Settings >		unknown	
	Help			
Channel locations			No (labels only)	
ICA weights			No	
and the space				
Transa sine (MA)				
Dataset Size (ND)			15.3	
Dataset size (Mb)			15.3	

So, now, we will specifically plot only these two electrodes.

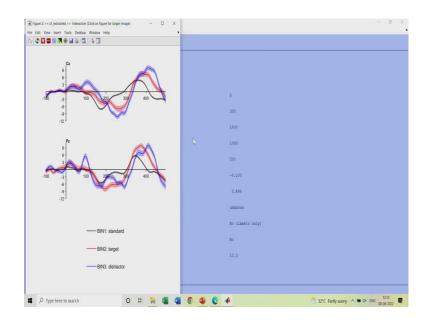
#### (Refer Slide Time: 32:27)

#5:s1 filt elist be ar	ERPLAB 8.30 - ERP Plot	ing GUI - s1_extracted			- = ×	
	Bins to plot		Channels to			
	include number of bin in le		show nu	nber of channel instead of	abel	
filename: none	al bis	Browse	all chann	vels	Browse	
				3.4		
hannels per frame	Scales Time range (min mai, in ms)	ERPSET	_ include I	IGFP from these channels	sine	
ames per epoch	-100.0 499.0	tme icis				
ochs	auto tre-tois		Baseline Co	Post Ocuston	rpose) (nin mai, in ms)	
rents	Y range (min max, e.g10 : -12.0000 11.0000	V tacks. Legend p		Owhore	-100.0 0	
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ooch end (sec)	transparency	Set Fort		Arts tick labels Ro		
efezence	positive is up	IE SPEC 10		10 4 2	2 1 V	
unnel locations	CANCEL CO	sé Figures RE	et ?	Scalp map	PLOT	
CA weights		No				
ataset size (Mb)		15	.3			

And it will give you an idea what is SEM. For that I will just do a classic ERP. I will turn the SEM on instead of selecting all channels I will just select third and fourth channel. So, now if you see third and fourth channel and I want to see here you can select how many you know rows and columns you want. I can just opt for, I just want it in 2 row and 1 column. So, I will just take 1 column here.

So, I can put the things exactly next to each other below just below each other. And now if you see the Y scale has also reduced because F PZ has had more fluctuations in the previous graph, if you see this now.

(Refer Slide Time: 33:16)



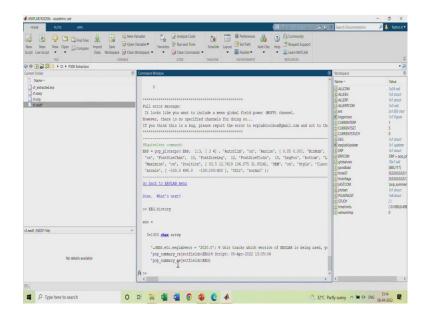
If you see this, you can see the graph. Now why did I do this? Just to show you the SEMs. So, this light color you know things is nothing but your SEMs, you can see that even SEMs are getting separated. SEM is nothing but your variabilities. During all the 100 trials it would have gone slightly up slightly down also, but it also follow this thing. So, this concludes that you can see this P 300 it is there. And also, it is getting generated using your target or distractor stimuli.

(Refer Slide Time: 33:58)

(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 KA			
Inspect/fabel components by map Classify components using ICLabel	Label components	8	
Classify components using ICLabel Remove components from data Extract exochs	Flag components as artifacts View extended component properties	300	
Locate dipoles using DIPHT Remove epoch baseline		1000	
Events		1093	
Sampling rate (Er)		500	
Epoch start (sec)		-0.100	
Epoch end (sec)		0.498	
Reference		unknown	
Channel locations		No (labels only)	
ICA weights		No	
Dataset size (Mb)		15.3	

Another thing is you can use this thing to resample it if you want, you can do all this reinforming. ICA is also a very important topic Independent Component Aanalysis in your eeg, then how many approximately how many components are lying there. So, accordingly you can remove your unwanted components and check the things. Now, one last very important point, you have seen how I have used gui to do this thing. Suppose I have a data from 500 patients or 500 subjects of this sort of data, what do I do? How can I get it done using scripting?

(Refer Slide Time: 34:37)



So, what you can do is whatever I have done so far in eeg lab there is a command eeg.history. If you hit that command, it will tell you that I have done this machine ok fine.

## (Refer Slide Time: 34:56)

(Expand tool choices via "File > Pteletences")			
Change sampling rate			
Filter the data >	Basic FIL Siter (new, default)		
Re-reference the data Interpolate electrodes	Windowed sinc FIR filter Parks-McClellan (equiripple) FIR filter		
Inspect/heject data by eye Reject data using Clean Rawdata and ASR	Moving average FIR filter Basic FIR filter (legacy)		
Decompose data by ICA Inspect/label components by map Classify components using IICabel >> Classify components using IICabel >>		8	
Remove components from data Extract epochs		360	
Locate dipoles using DIPHT > Remove epoch baseline		1000	
Events		1093	
Sampling rate (Er)		500	
Epoch start (sec)		-0.100	
Epoch end (sec)		0.498	
Reference		unknown	
Channel locations		No (labels only)	
ICA weights		No	
Dataset size (Mb)		15.3	

What I will do is I will again import the data or let us say I will do the filtering, basic filtering to your initial data.

(Refer Slide Time: 34:59)

•

#5: s1_filt_elist_be_ar	
	■ Filter the data pop_englithew() □ X
Filenane: none	Lower edge of the frequency pass band (Hz)
Channels per frame	Higher edge of the frequency pass band (Hz)
	FIR Filter order (Mandatory even. Default is automatic*)
Frames per epoch	"See help text for a description of the default filter order heuristic. Manual definition is recommended.
Epochs	Notch filter the data instead of pass band
Events	Use minimum-phase converted causal filter (non-linear!; beta)
Events	Plot frequency response
Sampling rate (Hz)	Channel type(s)
	OR channel labels or indices
Epoch start (sec)	Help Cancel Ok
Epoch end (sec)	
Reference	unknown
Channel locations	No (labels only)
ICA weights	No
Dataset size (Mb)	15.3

Because this thing already we have done it is just to show you a glimpse of how you can convert gui to scripting.

# (Refer Slide Time: 35:07)

(Expand tool choices via "File > Preferences")			
Change sampling rate			
Filter the data	) Pasic FIR filter (sew, default)		
Re-reference the data Interpolate electrodes	Windowed sinc FIR filter Paris-McClellan (equinpple) FIR filter		
Inspect/reject data by eye Reject data using Clean Rawdata and ASR	Moving average FIR filter Basic FIR filter (legacy)		
Classify components using ICLabel		8	
Remove components from data Extract epochs		449999	
		1	
Events		1102	
Sampling rate (Hz)		500	
Epoch start (sec)		0.000	
Epoch end (sec)		899.996	
Reference		unknown	
Channel locations		No (labels only)	
ICA weights		No	
Dataset size (Mb)		18.4	

# (Refer Slide Time: 35:10)

#1:s1	
Filename: none	💽 Filter the data pop_eeg/iltreni() D X
rilename: none	Lower edge of the frequency pass band (Hz)
Channels per frame	Higher edge of the frequency pass band (Hz)
	FIR Filter order (Mandatory even. Default is automatic*)
Frames per epoch	"See help text for a description of the default filter order heuristic. Manual definition is recommended.
Epochs	Notch filter the data instead of pass band
Events	Use minimum-phase converted causal filter (non-linear!; beta)
EVents	Plot frequency response
Sampling rate (Hz)	Channel type(s)
	OR channel labels or indices
Epoch start (sec)	
Epoch end (sec)	Help Cancel Ok
about one (nex)	
Reference	unknown
Channel locations	No (labels only)
ICA weights	Жо
Dataset size (Mb)	18.4

(Refer Slide Time: 35:16)

HOME PLOTS APPS				2		00	Search Documentation	👂 💄 Rathin
New New Open Compare pt Live Script • RLE	Import Save Data Workspace	Favorites Run and Time	Simulink Layout SANULINK ENVROMMENT	Add-Ons Help	Community Community Request Support Learn MATLAB RESOLACES			
D: • P300 Extraction	() ()					۲		
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st extracted.erp							Name -	Value
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st.ned		0					ALLERPCOM ars	100 stil 103 cel 3x1303
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	7	ull error message:					CURRENTERP	1
		It looks like you want to inc	lude a mean global field po	wer (MGEP) o	channel.		CURRENTSTUDY	0
		owever, there is no specified					EEG EEG	the 1 st
		f you think this is a bug, pl		plabtoolbox	gmail.com and no	t to th	eeglabUpdater	la la
							ERPCOM	ERP :
	1	Equivalent command: EP = pop_ploterps( ERP, 1:3, 'on', 'FontSizeChan', 10, 'Fo 'Maximise', 'on', 'Position', 'xscale', [ -100.0 498.0 -1)	ontSizeLeg', 12, 'FontSize' [ 83.5 12.7619 106.875 31.	ticks', 10, 9524], 'SEM'	"LegPos", "bott	om', 'L	goodbad histeE histeE LASTCOM gootset FRUGNUST	10x1 c (883,1 (10,0,1) (0,0,0,1) (0,0,0,1) (0,0,0,1) (0,0,0,1) (0,0,0,1) (0,0,0,1) (0,0,1)(0,0)) (0,0,1)(0,0)(0,0))(0,0)(0,0)(0,0))(0,0)(0,0
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df (NEDF File)	* >	> EEG.history						
	a	55 =						
No details availab	e .	3×1303 char array						
	fi,	'pop_summary_rejectfields(	20.0': % this tracks which SBG(% Script: 08-Apr-2022 1		EBGLAB is being	used, yc	<	
						,		

Anyways if you scroll here, you can see equivalent command everywhere. When you are plotting this is equivalent command.

(Refer Slide Time: 35:19)

HOME PLOTS APPS		Search Documentation 🤌 💄 Rathin K 🕯
Line         Line         New         New<	Visitable L A Grant Connection Notable C A Connectio	
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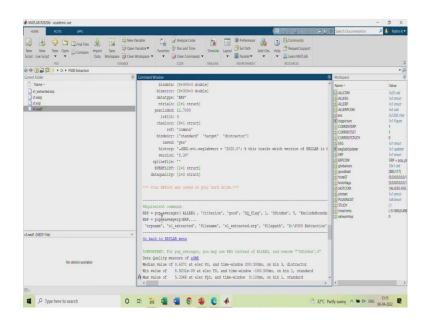
If you even go before, we plot it twice this is plotted using topographical view. So, style is topographical whereas, this was plotted using your normal view classic ERP. So, style is classic ERP.

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Also, when we plotted second time we have turned SEM on. So, this SEM is on.

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Basically, for each command which you give in your gui or eeg lab there will be a equivalent command here. When we I did averaging it was this, we kept this dataset DQ flag on, data set option. So, it is 1. While saving it we have given this name. So, this is the name saved ERP will be saved here you can see here.

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Also, if I go further below you know ahead this was what we have used artifact rejection for all 8 channels 100,  $\pm 100$  millisecond.

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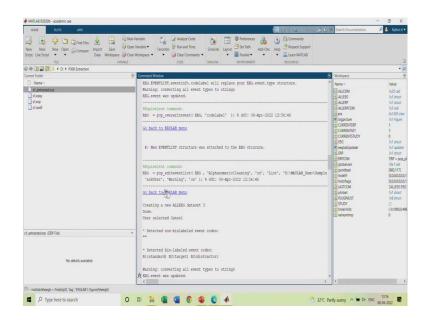
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So, similarly this is just a summarization of artifact rejection before that we did pop epoch bin.

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So, it is like a highlight after cricket or any match you see the highlight, same thing after doing all this thing using gui if you go through the command window you can see the highlight of equivalent commands what you have done. So, when you have multiple files or multiple subjects you can use all this command run a for loop and you can get the things done very easily.

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This is to check the artifact is there or not, the same thing.

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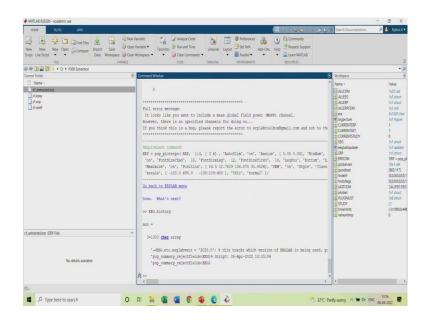
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So, this is from you know checking the spectrum till getting the ERP done everything can be done using scripting.

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So, this is an overall idea. This is advisable when you are doing badge file processing, also further if you want you can go to you know plot any do ERP imaging and all sorts of thing based on your requirement you can explore this thing at your own. There is an excellent documentation available for eeg lab as well as ERP lab. And it is very important when you are processing data and to make sense out of your you know recorded eeg data.

So, that is basically a short module on how you can extract the ERPs using data. If you have any question or anything, feel free to write in the forum. Maybe I will see you guys in some other course next time. Till then, all of you take care, bye.