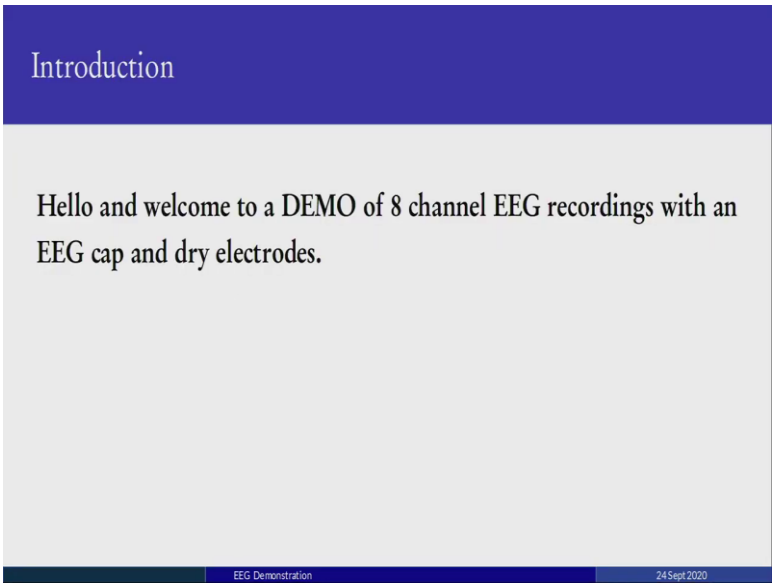
Introductory Neuroscience and Neuro Instrumentation
Professor Mahesh Jayachandra
Professor Hema Hariharan
Center for Bio-Systems Science and Engineering
Indian Institute of Science, Bangalore
Lecture 61
Demo: Wireless EEG with Dry electrodes

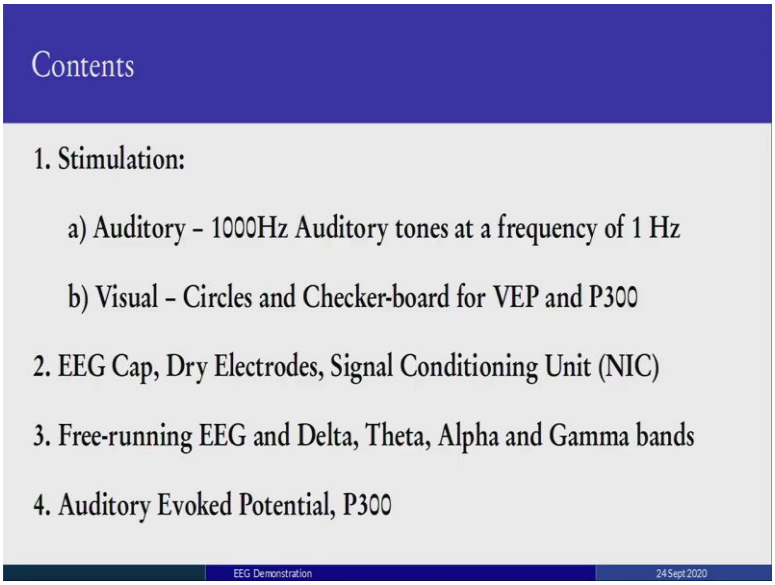
Introductory Neuroscience and Neuro Instrumentation Demo Wireless EEG with dry electrodes. In this demo, I will be assisted by Hema Hariharan who is a training teaching assistant on this course.

(Refer Slide Time: 0:33)



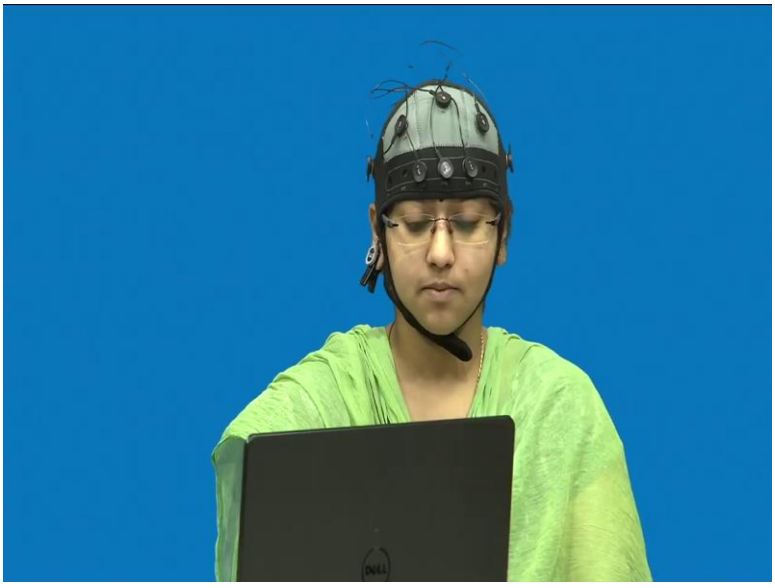
So hello and welcome to a demo of 8 channel EEG recordings with the EEG cap and dry electrodes.

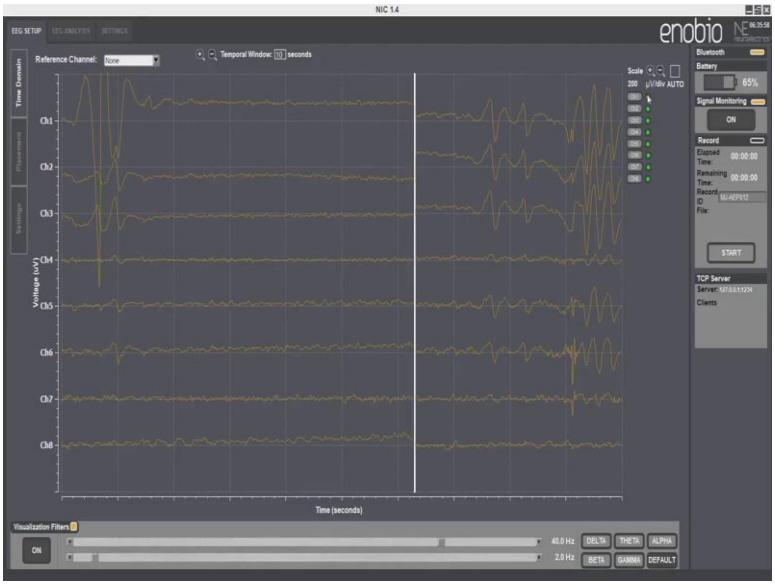
(Refer Slide Time: 0:40)



The contents of this demo will include stimulation auditory tones at a frequency of 1 hertz EEG cap, dry electrodes, and a signal conditioning unit, free-running EEG and delta, theta, alpha and gamma bands, and the auditory evoked potential.

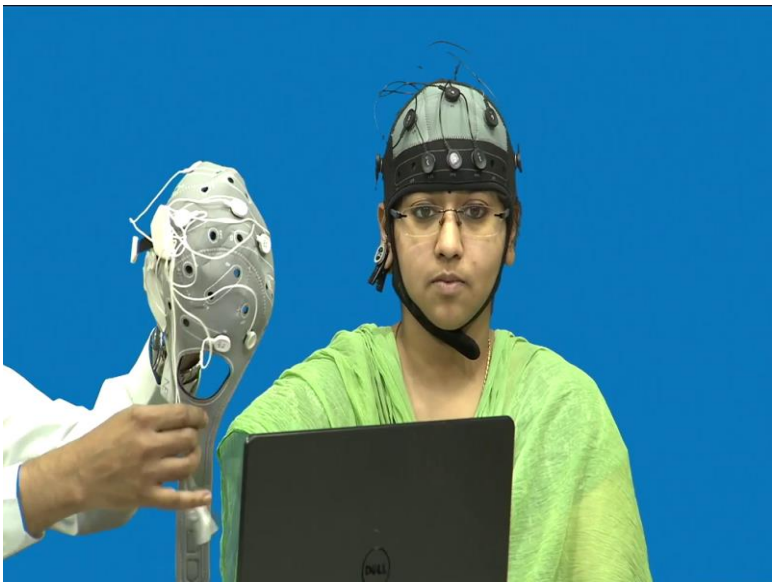
(Refer Slide Time: 1:02)





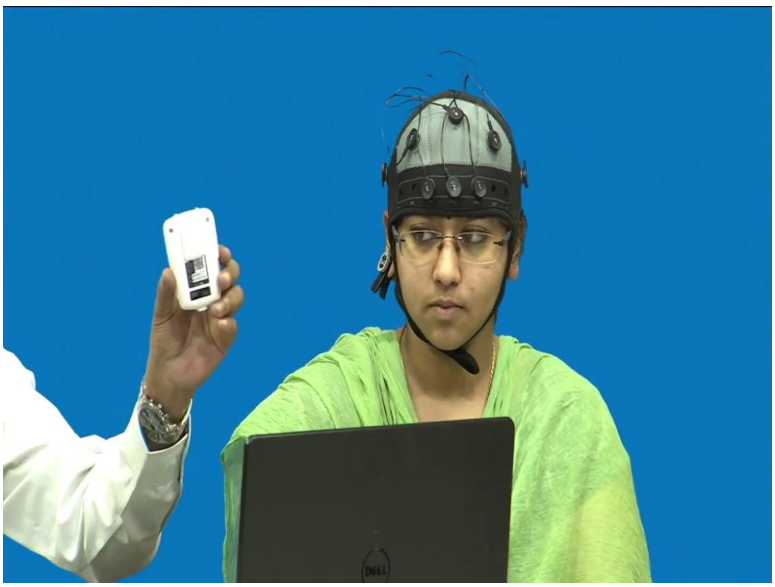
So here we have an eight-channel EEG electrode which has been put on the subject's head, you can see the EEG recordings happening and on the side over here you have 8 green channels which shows 8 electrodes the impedances are very good Hema will be telling you about the impedances when she talks. And we have set the scale at 200 microvolts and this is just free running EEG, what we are using is enobio 8 which is a dry channel system.

(Refer Slide Time: 1:42)



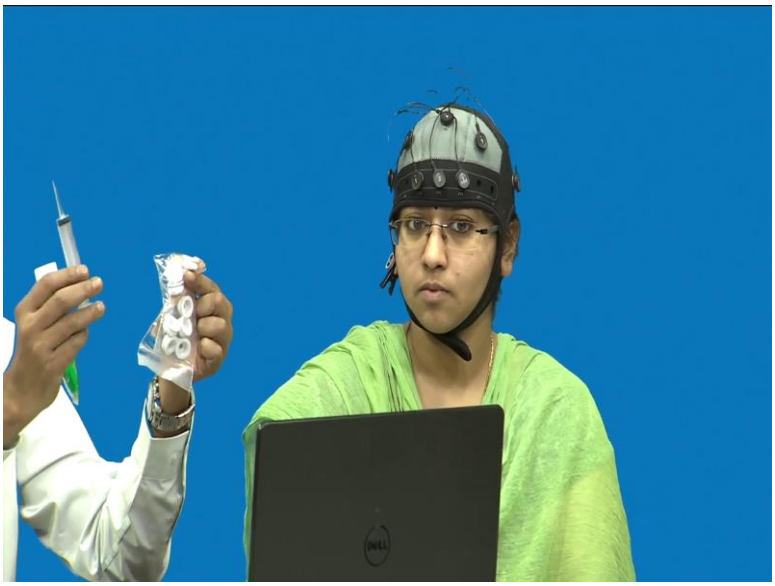
This is the enobio 8 system and it has got 8 channels and we have a ear clip which we have attached to Hema's right ear and the ear clip has two electrodes, one electrode is the reference and the other electrode is the ground, so that is over here. And the electrodes we are using are these comb electrodes or dry electrodes, you can see each electrode has a prong on it, 11 10 prongs and even if one prong touches the scalp we get good recordings as you can see it is all green on the impedances.

(Refer Slide Time: 2:19)



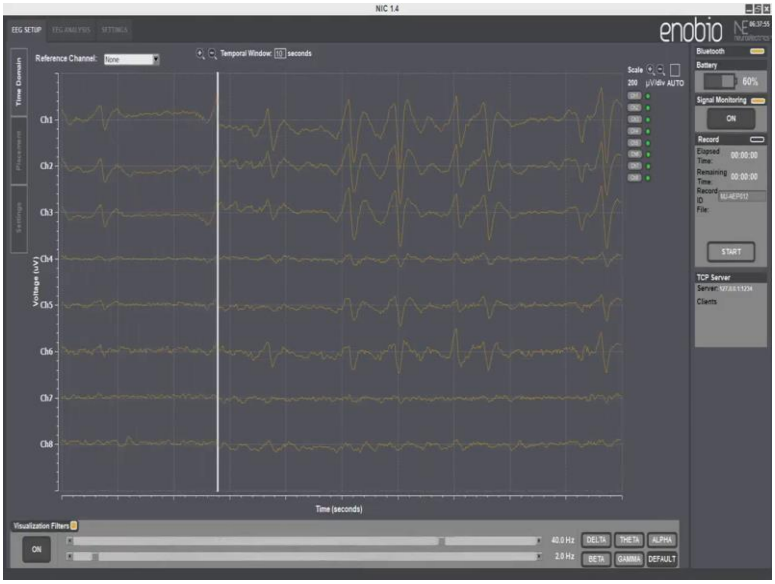
And this leads to an impedance you know, I am sorry this leads to an NIC conditioning unit signal conditioning unit and the signal conditioning unit has a preamplifier, filters, amplifier, a notch filter, and a wi-fi module by which it transmits the signals to the laptop.

(Refer Slide Time: 2:43)



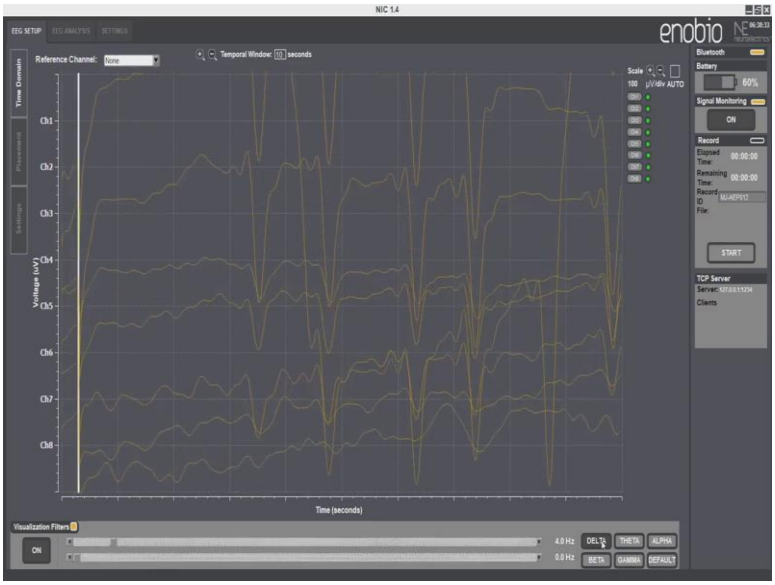
And in case you use wet electrodes then we have electrodes which are like this and we use this gel we use a syringe to insert the gel into the electrodes and then we can get recordings, this is a little uncomfortable for the subject because you get all this conductive gel goop on your head which you have to wash off.

(Refer Slide Time: 3:10)



So now coming back to the EEG, we will show some maneuvers. So first of all this is free running EEG and, surprisingly, we are getting such good recordings in a studio full of electronic equipment. So normally you will have a lot of AC and contamination in the signal. So free running EEG will increase the scale so that is this is the usual scale of 100 microvolts per division. So now this is the default EEG, so let us look at just the delta band.

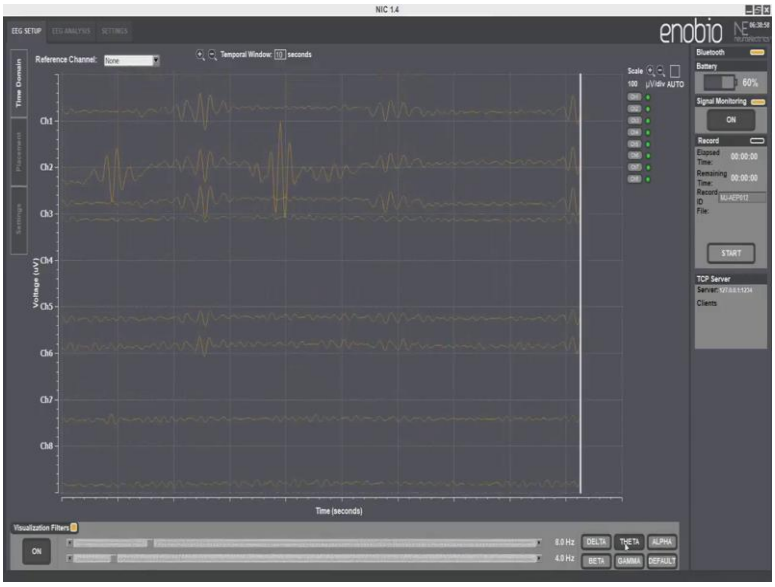
(Refer Slide Time: 3:41)



So we can visualize the delta band I press the button over here and the delta band if you remember is 0 to 4 hertz and it is slow waves and usually, it is prominent when you are sleeping. Here we are filtering the EEG, the EEG has all the bands, so we are filtering it and

we are just looking at the delta band. The big jerks up and down that is because Hema is blinking or she is moving her eyes, so this is the delta band.

(Refer Slide Time: 4:06)

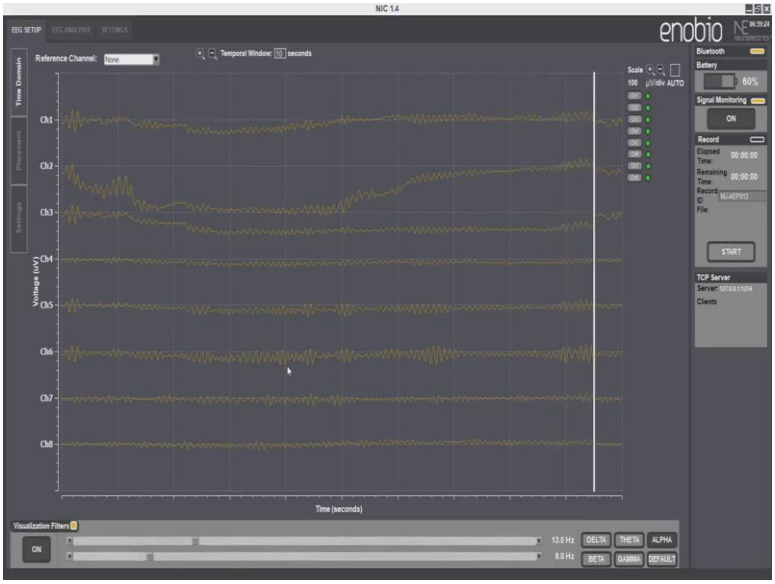


So now we look at the theta band, so theta band is from 4 hertz to 8 hertz and this you have in the scalp recordings when the person is kind of drowsy a little bit.

(Refer Slide Time: 4:23)

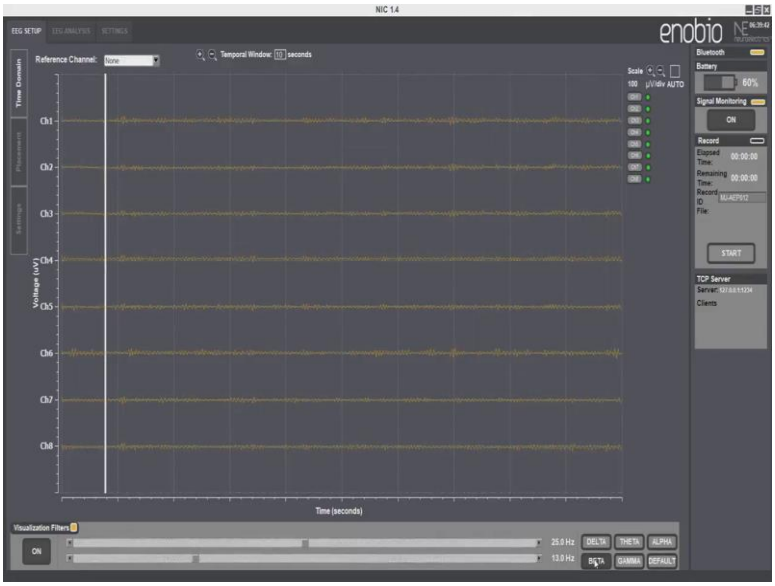
And now we look at alpha band, an alpha band is between 8 to about 11 hertz and Hema if you could, when I tell you if you could just close your eyes, now.

(Refer Slide Time: 4:35)



So you see the bus happening over here, so these are alpha bus, so this happens when a person is relaxing or meditating, so you can open your eyes.

(Refer Slide Time: 4:49)



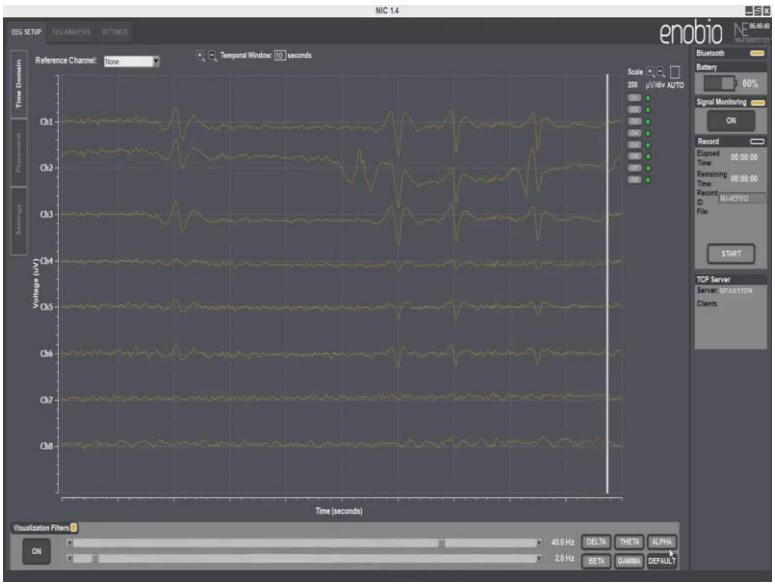
So it becomes less and then you have the beta band this is the normal band which you record which predominates a normal ECG, I am sorry EEG and this is between 12 to about 20 hertz.

(Refer Slide Time: 5:02)

And then finally you have the gamma band which is about 30 and these are high-frequency bus and I can increase the magnification, so that yeah so these are very small amplitude high frequency things so you can barely see it let me change it even further, so these are the gamma bus which you get from EEG, cool.

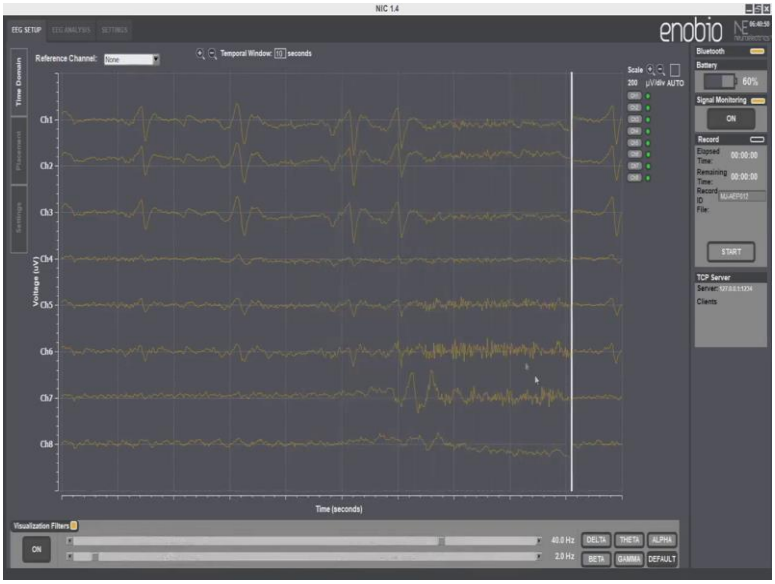
So we shall get back to the normal 100 200 and we are looking at defaults. So now we will show some manipulations what are the different artifacts you get. So I will go through a few artifacts and these are things which contaminate the EEG and you have to be very careful to remove them when you are doing the analysis.

(Refer Slide Time: 5:57)



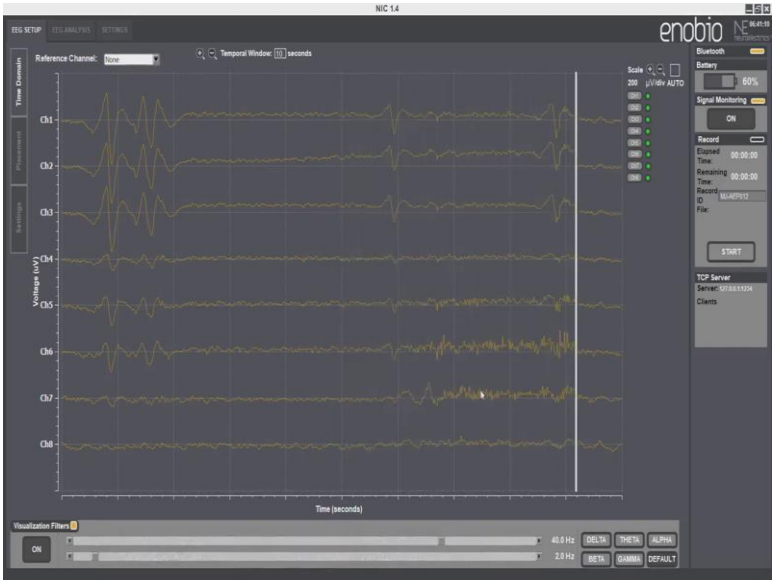
So Hema could you please blink? So this is the eye blink artifact, stop.

(Refer Slide Time: 6:07)



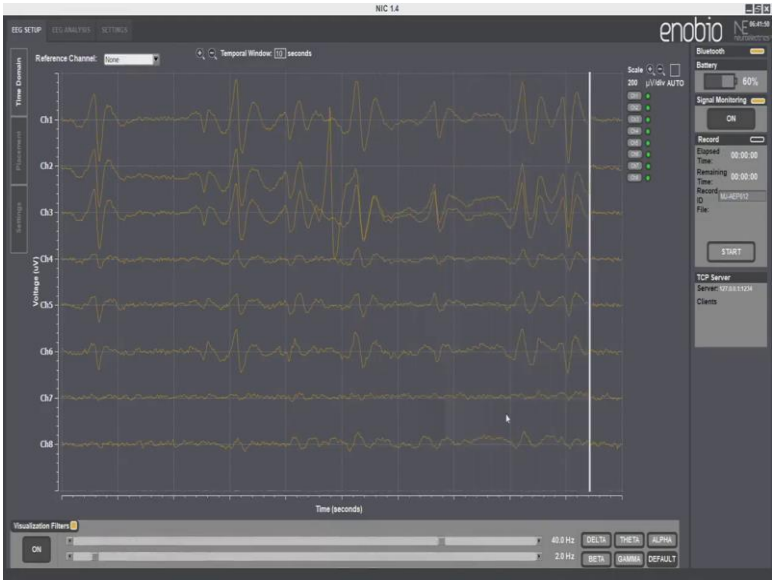
So Hema could you please clench your teeth? So you see this stuff over here so this is EMG activity she is also blinking but you also get this EMG activity over here and this is high frequency activity can be mistaken for beta or gamma. So we have to be very careful to take these artifacts out. Can you clench your teeth again?

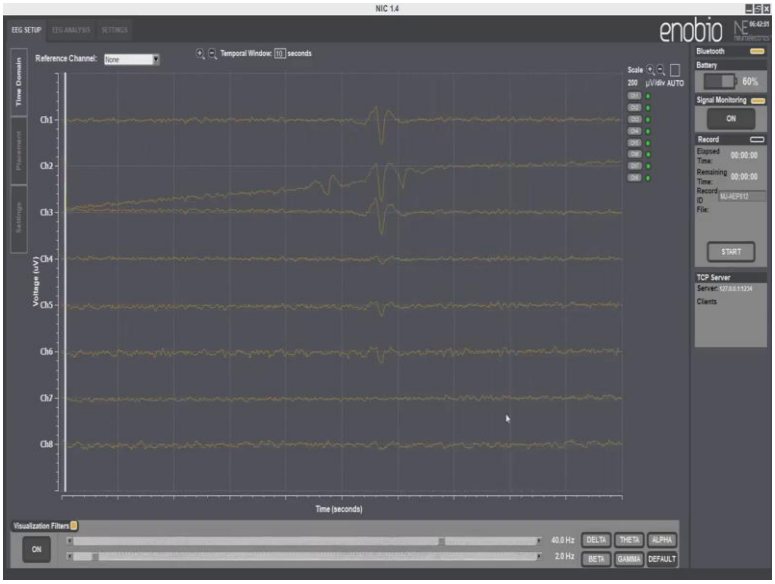
(Refer Slide Time: 6:27)

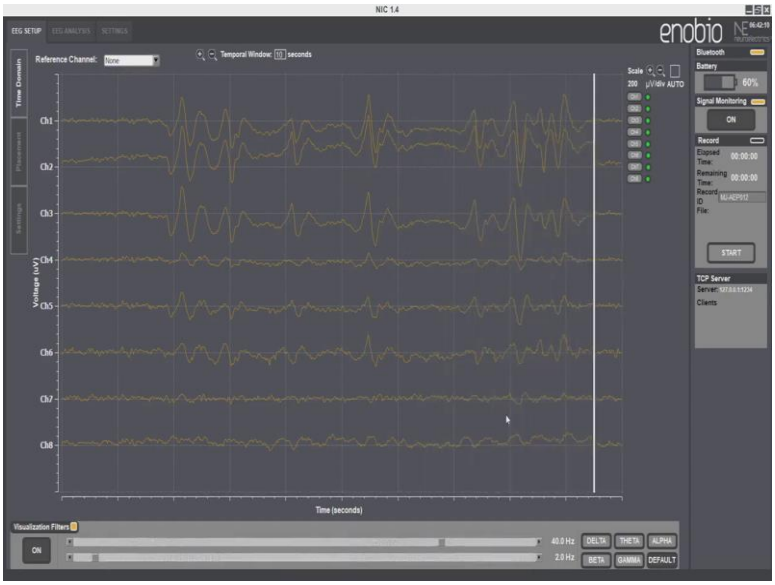


So all these are EMG activity, stop. Now another artifact where the eyes actually, if you look the structure of the eye in front of the lens is the aqueous humor, behind the lens is the vitreous humor and they have differing ionic compositions. So when you move your eyes, there is a dipole and that causes artifacts. So and it made worse by the fact that both the eyes move together it is called conjugate movements. So Hema can you move your eyes?

(Refer Slide Time: 7:03)

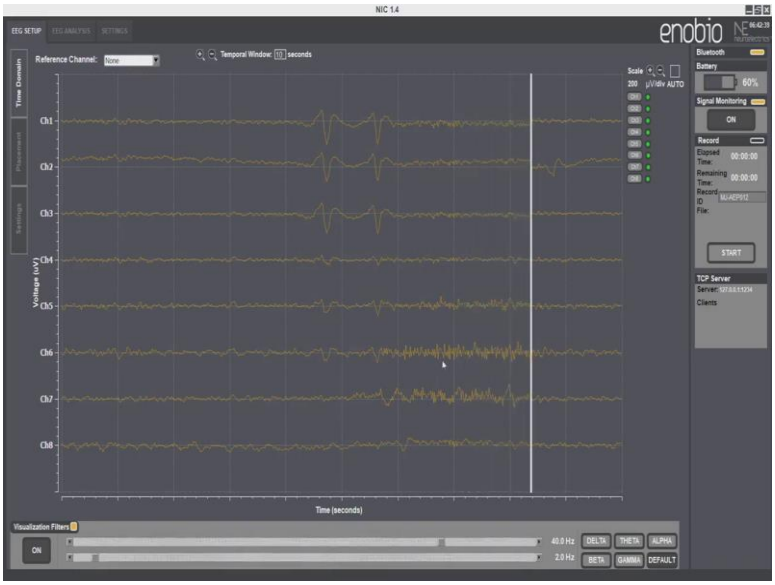






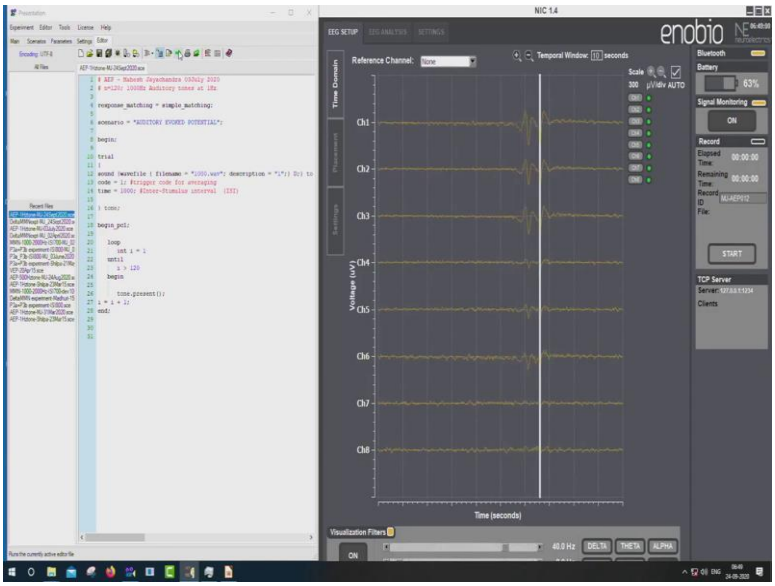
Can you stop? Can you move your eyes, please? So these are the ocular dipoles moving. Stop. Can you please blink? They are kind of similar in amplitude but different compared to the ocular dipoles.

(Refer Slide Time: 7:55)



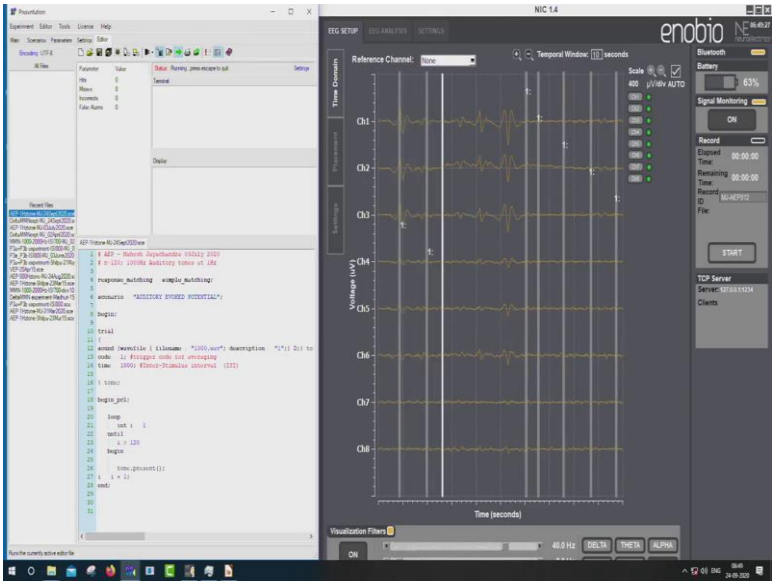
Can you clench your teeth please? Just to reiterate these are the EMG thing artifacts. So all these artifacts can generally be removed very simply if you just set your window, your amplitude window to plus-minus 100 microvolts and run this window through your raw EEG recordings and that will take off most of the artifacts, there are different algorithms which are used to take out artifacts but the simplest one is a moving amplitude window.

(Refer Slide Time: 8:27)



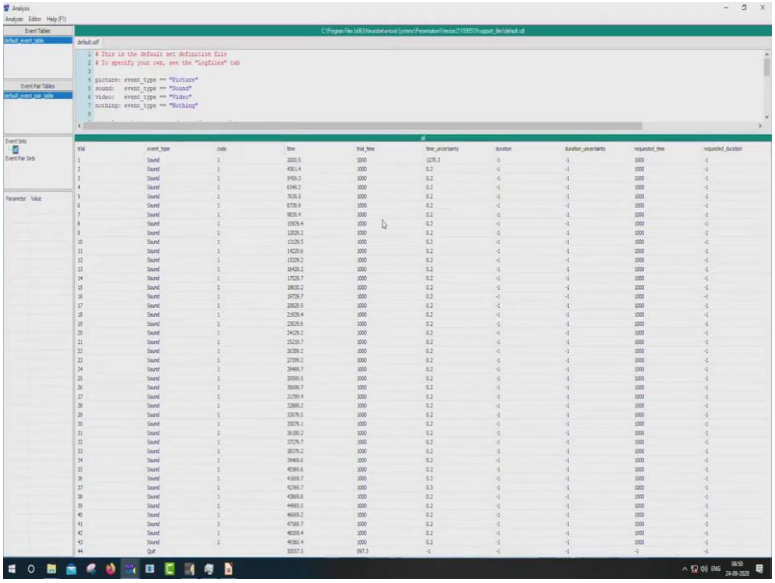
So we have the presentation software on the left panel which is giving auditory stimuli and this is an auditory work potential experiment. We have free-running EEG being collected from the subject's head 8 channels and we shall start and this is a 1000.

(Refer Slide Time: 8:52)



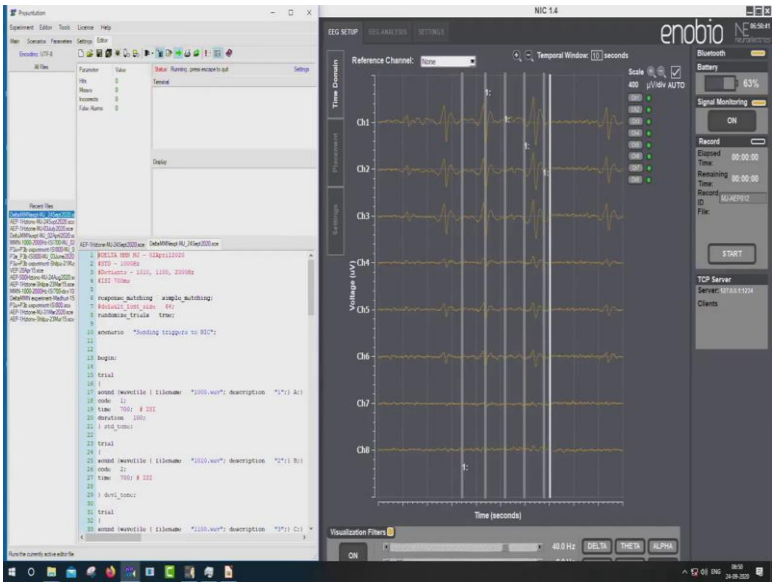
So this is a stimulus at a 1000 hertz is being given at a frequency of 1 hertz and we usually use an average of a 100, so we give a 120 stimuli in case we have some problems with artifacts we have to throw them out, so even if we throw out 20 we still have a 100. So you see the stimuli being given over here and it is not exact, yeah so that is basically it and I shall stop it now.

(Refer Slide Time: 9:38)



So at the end of the stimulus, you have a log of the different stimuli which were given, what are their triggers because you need to average them according to their triggers and the interstimulus interval if there is a response and so on and so forth. So you have a log file at the end of it.

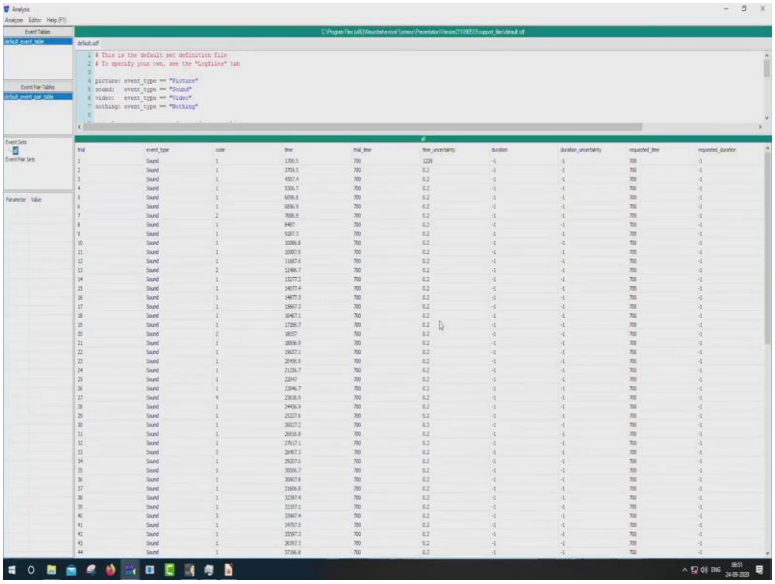
(Refer Slide Time: 10:07)



Alright, and now so here this is an MMN experiment where every 5 stimuli we have a slightly different tone. So there are three different tones it is a delta MMN, so the first the standard stimulus is at a 1000 hertz and the three stimuli are different deltas. So first you have a delta of 10 then you have a delta of 100 and then you have a delta of 2000. The reason we chose this is that in physiology usually a power function is involved, so we are looking at a delta of 10, 100 and a 1000.

The actual stimuli are a 1000 for the standard, 1010 hertz for the first deviant, the second deviant is 1100 hertz and the third deviant is 2000 hertz. Now the stimuli of each of these are different, we have coded them differently, 1, 2, 3, and 4 so that we can average them separately and subtract them for the MMN response.

(Refer Slide Time: 11:17)



And now these are the log of the experiment we did so far, if you look at the code you see different stimuli triggers these are the standards, then you have a deviant over here then you have standards another deviant over here, standards, another deviant over here, and so on and so forth. So these deviants are given randomized in a randomized fashion so that we are actually looking at the brain response to different MMN stimuli in these experiments, thank you.