EEG BASICS

May 8, 2024

1 Introduction

1.1 International 10-20 sysytem

In general we will follow international 10-20 system for places electrodes on human head.In this system we will first divide the line connecting the nasion , inion and 2 pre auricular points by 10,20,20,20,20,10 percentages respectively as shown.

On the elliptical curve joining the extreme points we have to mark points with 10 percentage separations starting from any extreme point of horizontal line(line joining pre auricular points).And we have to place 4 extra points as shown with 25 percentage separation.

The standard positions where we will place the electrodes according to 10-20 system are shown in figure 3. Fp- pre frontal F- frontal C-central P-parietal O-occiptal T-temporal suffix Z- zero Odd numbered positions are in left,and lower numbered are nearer to vertical line.

1.2 Differntial amplifier

It will gives an output signal which is difference between two input signals.

Convention of polarities:

If the output signal of input1-input2 is as shown in fig 4,then input1 is said to be negative relative to input2 or input2 is said to be positive relative to input1.

If the output signal of input1-input2 is as shown in fig 5,then input2 is said to be negative relative to input1 or input1 is said to be positive relative to input2. If the output signal is almost flat then those 2 are said to be isoelectric(neutral w.r.t to each other).

2 Some common EEG patterns

2.1 Due to eye moments

We will consider the eye as a dipole with the cornea is of postively charged and retina is of negative charge.

Blinking of eye

If we close our eye the eye ball will rotates up so that Fp1 and Fp2 will get relatively more positive charge than F3,F4,F7,F8 and these four are relatively positive than C3,C4,T7,T8(almost no change in

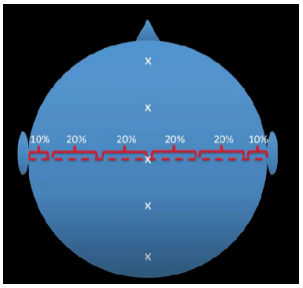

Figure 1:

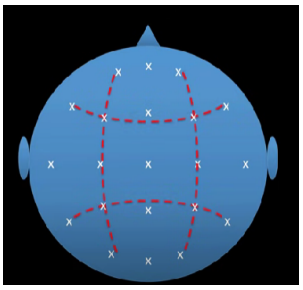

Figure 2:

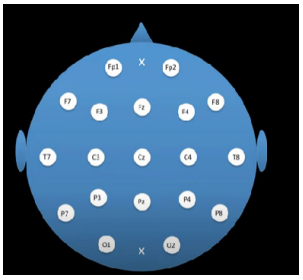

Figure 3:

Figure 4:

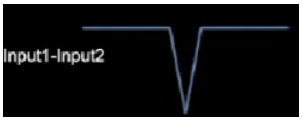

Figure 5:

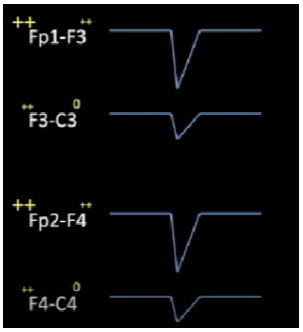

Figure 6:

Figure 7:

these due to eye moments).so the patterns are as shown in fig6 will occur. **Horizantal movement of eyes**

suppose if we move our eyes to left then then cornea of left eye becomes closer to F7 and right eye's retina becomes closer to F8,as a result F7 becomes electropositive , F8 becomes electronegative and the remaining points are almost unchanged.So in montage patterns as shown in figure7 will occur.

2.2 Alpha rhythm

we can observe some continuous pattern with almost constant frequency around 8-12hz. This frequency will be higher in adolescence or early adulthood

2.3 focal epileptiform discharges

A pattern as shown in fig 8 will be observed.It will depend on location of cortex and the area of cortex from the electrode(i.e. if the cortex is deeper inside the brain the affect will be less and also if the area is more the affect will be more)

2.4 generalised epileptiform discharges

A continuous repeated patterns(same as focal epileptiform discharges) will be observed mainly in the people who has epileptiform syndrome.

3 Types of montages

3.1 Bipolar montage

In this montage we will put electrodes at any of the 2 adjacent positions as shown in figure 3 (systematically).There are types of montages

Anterior-Posterior bipolar montage

In this type of montage we will collect the data with the chain going from front part to back part as shown in fig 9

transverse bipolar montage

In these type of montage we will collect the data with the chain going from left to right as shown in fig 10

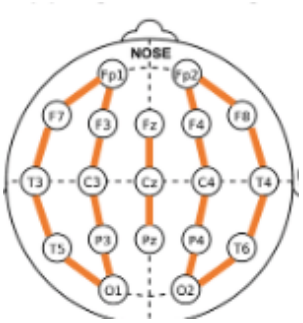

Figure 8:

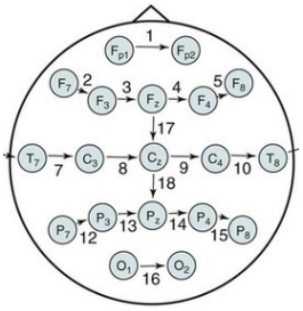

Figure 9:

3.2 Common reference montage

In these type we will take a node as a common reference for all others and take the data.In general we will take Cz as reference and there are 2 other commonly used montages

Ipsilateral Mastoid Reference Montage

Here for left nodes we will take left mastoid(a particular point on circumference of head) as reference and for right nodes we will take right mastoid(a particular point on circumference of head) as reference.

Contralateral Mastoid Reference Montage

Here for left nodes we will take right mastoid(a particular point on circumference of head) as reference and for right nodes we will take left mastoid(a particular point on circumference of head) as reference.

3.3 Average reference montage

Here for every node we will take the average of remaining all nodes except that one as the reference.

3.4 Laplacian montage

here for every node we will take the the average of nearest neighbours as the reference.for example for F7 Fp1,T7,F3 are the nearest neighbours.

4 Filtering and scaling

4.1 Low Frequency Filter(LFF)

By using this filter we can reduce the signal with frequency lower than the given frequency(also known as High Pass Filter). In general for an average filter the amplification corresponding to the given frequency will be about 80 percentage and for the frequencies less than that it will decrease gradually.

4.2 High Frequency Filter(HFF)

By using this filter we can reduce the signal with frequency higher than the given frequency(also known as low Pass Filter). In general for an average filter the amplification corresponding to the given frequency will be about 80 percentage and for the frequencies greater than that it will decrease gradually.

4.3 Notch filter

Actually due to the AC(alternating current) devices there will be extra 60hz signal (let AC is of 60hz) at every electrode which cancels out .But if there is any loosely connected electrode then the output will consist of 60 Hz signal which can be filtered by giving 60hz in notch filter.

4.4 Sensitivity

We can change the scale of amplitude axis in graph by changing sensitivity.

4.5 Time base

We can change the scale of time axis in graph by changing time base.