Bio-Medical ECG Signal Acquisition and Electrode Placements

Sachin Sambhaji Patil

Research Scholar, S.U.Kolhapur

Assistant Professor: ZCOER Pune

Pune, India

Dr. T. B. Mohite-Patil

Professor, D.Y.P.COE Kolhapur

Kolhapur , India

ABSTRACT

ECG is an Electrocardiogram that records the electrical activity of the heart. Cardiologists use ECG for the diagnosis of cardiovascular disease. In this, we are going to see How ECG signals get recorded and How ECG signals get plotted on the ECG Graph Paper.

Keywords—ECG, Acquisition, Image, Electrodes

# INTRODUCTION



**Fig.1: Limb Lead and Chest Lead Electrodes**

As shown in Fig-1, there are 6 chest bulb electrodes and 4 Limb electrodes. An electrocardiogram (ECG or EKG) is a register of the heart's electrical activity. Chest Electrodes are unipolar electrodes which measures electrical activity of heart in horizontal plane. Limb electrodes are bipolar electrodes which measures electrical activity of heart in vertical plane. 6 chest electrodes are V1 , V2 , V3 , V4 , V5 , V6 and similarly 4 Limb electrodes are black , red , yellow , blue. Chest electrodes are generating ECG Signals V1 , V2 , V3 , V4 , V5 , V6 and Limb electrodes are generating ECG Signals I, II , III , AVR , AVL , AVF .

Placement of 6 Chest Lead ECG Electrodes:

Measures Electrical Activity of Heart in Horizontal Plane

V1 – 4thintercostals space right rib

V2 – 4thintercostals space left rib

V3 – In between V2 and V4

V4 – Mid calvicular line

V5 – Anterior Auxiliary Line

V6 – Mid Auxiliary Line

Placements of 4 Limb lead Electrodes

Measures Electrical Activity of Heart in Vertical Plane

Black electrode – Right Leg

Red electrode – Right Arm

Yellow electrode – Left Arm

Blue electrode – Left Leg

ECG Signals: Potential Difference between Arm and Leg

I – Potential difference between Right Arm and Left Arm

II – Potential difference between Right Arm and Left Leg

III – Potential difference between Left Arm and Left Leg

ECG Signals: Looking into Heart in Cross Section

AVR – Augmented Vector Right

AVL – Augmented Vector Left

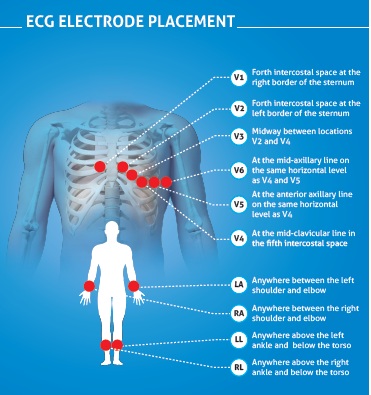
AVF – Augmented Vector Foot

Fig.2: ECG Electrode Placement

Different Types of ECG File Formats

csv file format

mat file format

edf file format

dat file format

Images form jpg, png, bmp

csv file format

csv stands for comma separated value . In this file format all the values are separated by comma.

How to read csv file in matlab

M = csvread ([filename](https://www.mathworks.com/help/matlab/ref/csvread.html#btq_2yi-1-filename))

Meaning of above matlab programming line is read comma separated value into array M. The file must contain only numerical values.

ECG Data File Format:-

1. mat file format

mat is a matlab laboratory file . This file is having extension is .mat. When we want to load .mat file

Download .mat file ECG Signal from Physiobank ATM. After downloading ECG Signal in .mat file load it in y.

y=load ('100.mat);

>> pwd , pwd stands for path word directory

>> pwd

ans =

C:\Program Files\MATLAB\MATLAB Production Server\R2015a\bin

>> ls, // ls means list of files available in given pwd

>> y=load ('100.mat);

1. edf file format

edf stands for European Data Format.

data = edfread( filename ) reads the European Data Format (EDF)

1. dat file format

 . dat file extension is a generic data file that stores specific information relating to the program that created the file.

1. Images form jpg,png,bmp

ECG signal available in Images format also like jpg,png,bmp etc.

The procedure of Connecting ECG Electrodes:-



Fig.3 Electrode Placement on Patient body

Fig.3 indicates placement of Electrodes on Patient body on chest placed bulb electrodes and on hands and legs placed limb electrodes.

Electrodes:-

Bulb Electrode – 6 Bulb Electrodes are connected to the chest to the rib

V1: 4th Intercostal Space Left, V2 – 4th intercostal space Right,

V4 - Mid Calvicular Line,

V3 – In between V1 and V4,

V5-Anterior auxiliary line,

V6 - Mid auxiliary line

Limb Electrode - 4 Limb Electrodes are connected to Hands and Legs

Black Limb Electrode-Right Leg, Red Limb Electrode-Right Arm,

Yellow Limb Electrode- Left Arm, Blue Limb Electrode – Left Leg

##### REFERENCES

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