

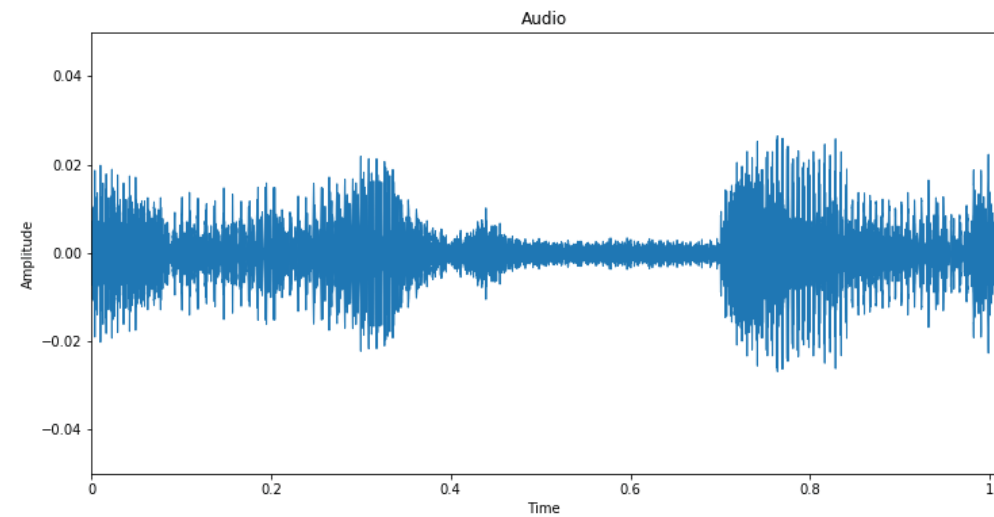
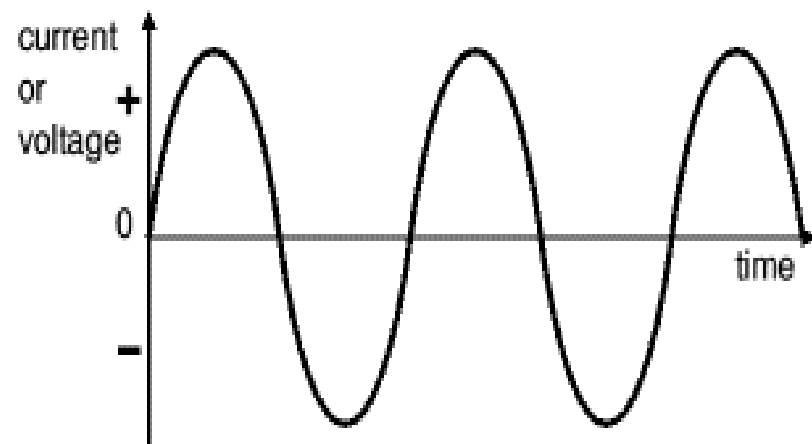
EEGLAB and ERPLAB

Interdisciplinary Schools
Signal Processing Department
Parisa Khoorahe

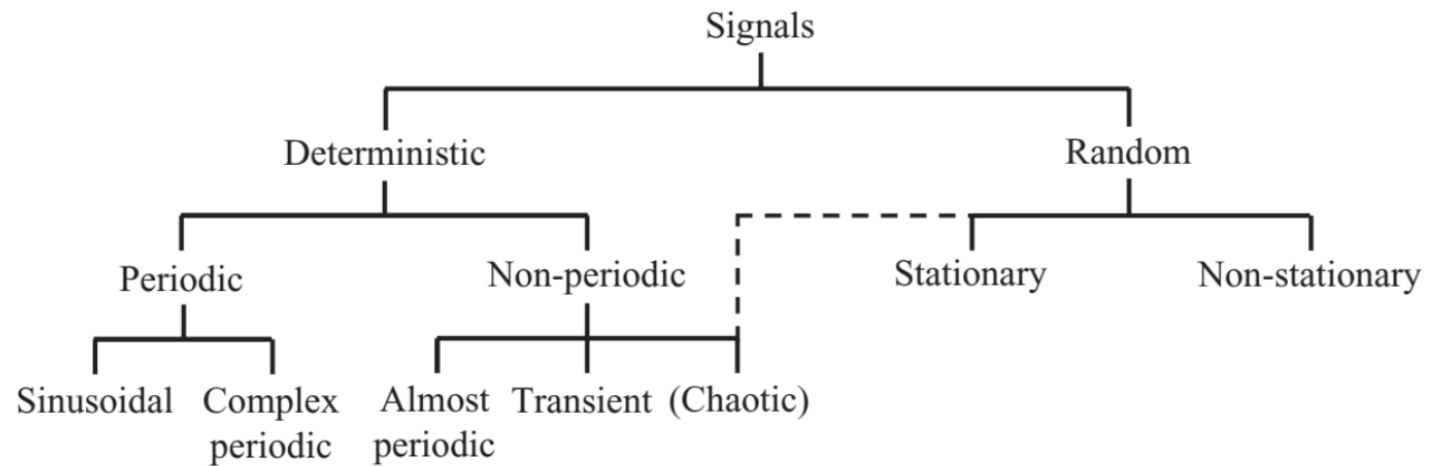
EEGLAB and ERPLAB

- + Introduction (session 1)
- + EEGLAB (sessions 2 & 3)
- + EEGLAB-ICA (session 4)
- + ERPLAB (sessions 5 & 6)

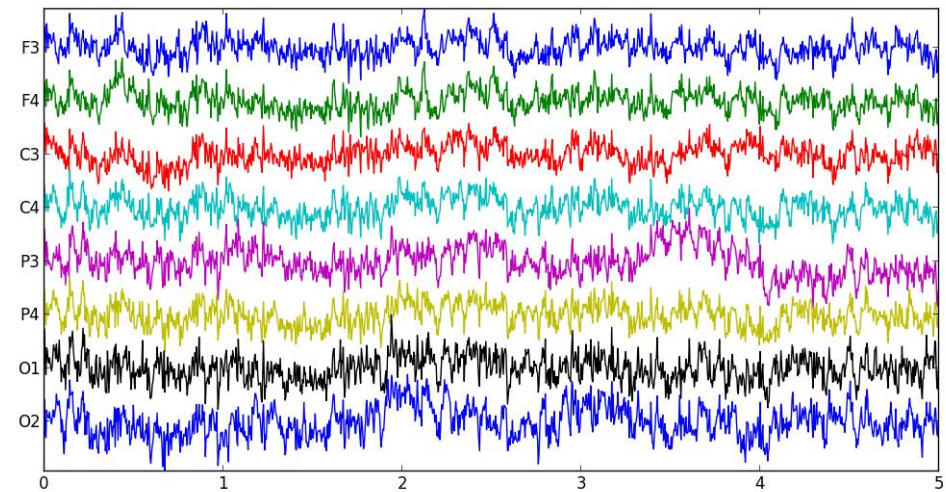
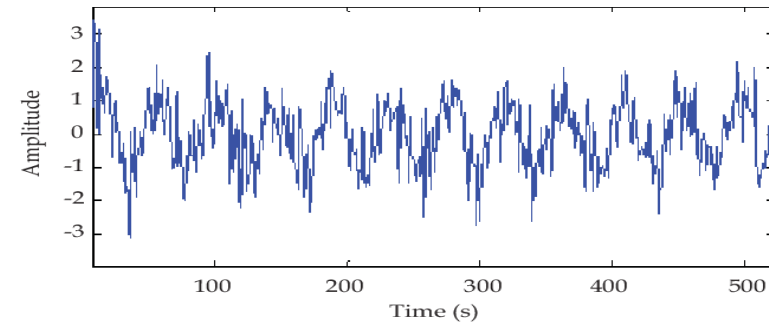
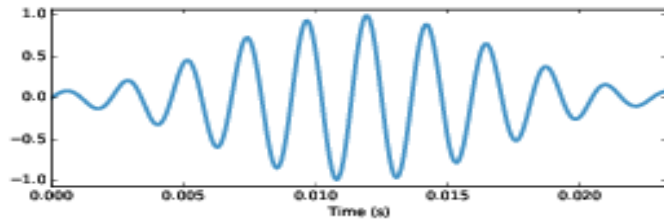
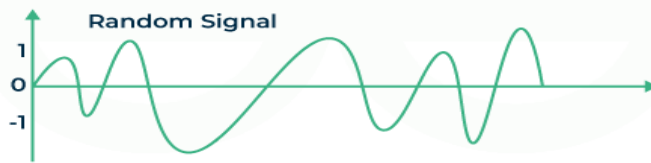
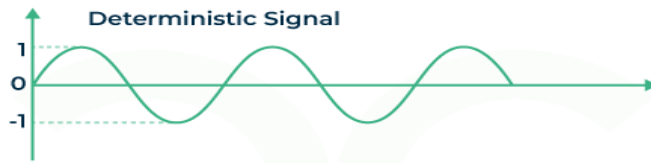
Signal



Signal Classification

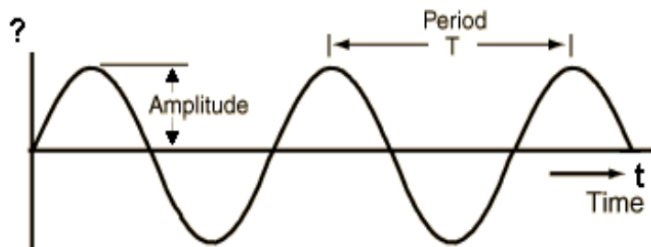
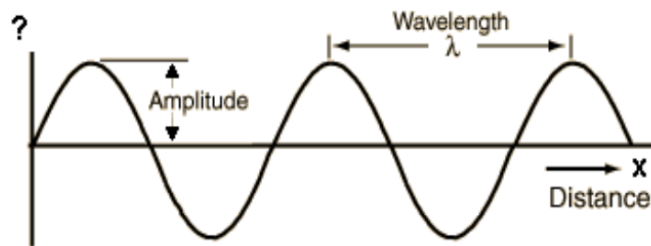


Signal Classification



Signal Characteristics

Characteristics of a sinusoidal signal

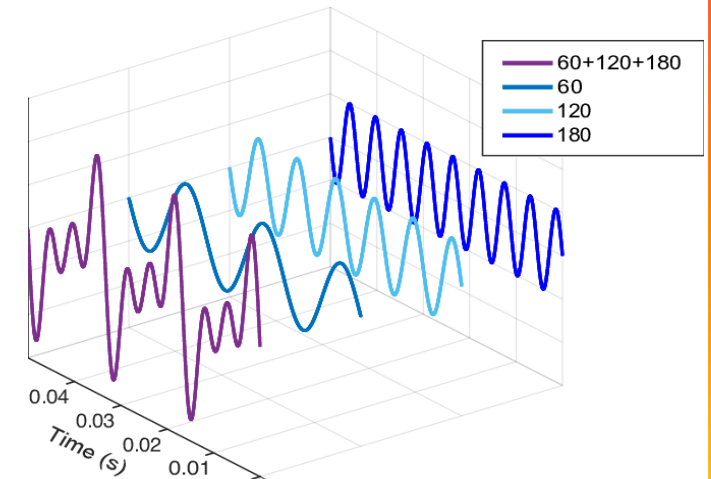


$$\begin{aligned} f &= \frac{1}{T} \\ f &= \frac{v}{\lambda} \\ f &= \frac{\omega}{2\pi} \end{aligned}$$

where,

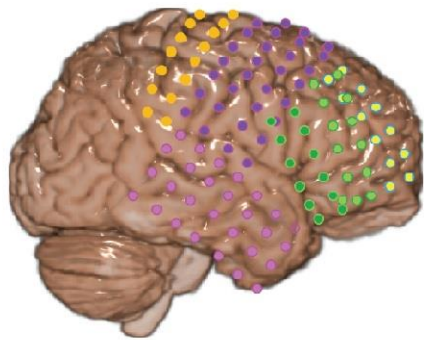
- f is the frequency in hertz, and
- T is the time to complete one cycle in seconds
- v is the wave speed, and
- λ is the wavelength of the wave
- ω is the angular frequency

$$x(t) = A \sin(2\pi f t + \phi)$$

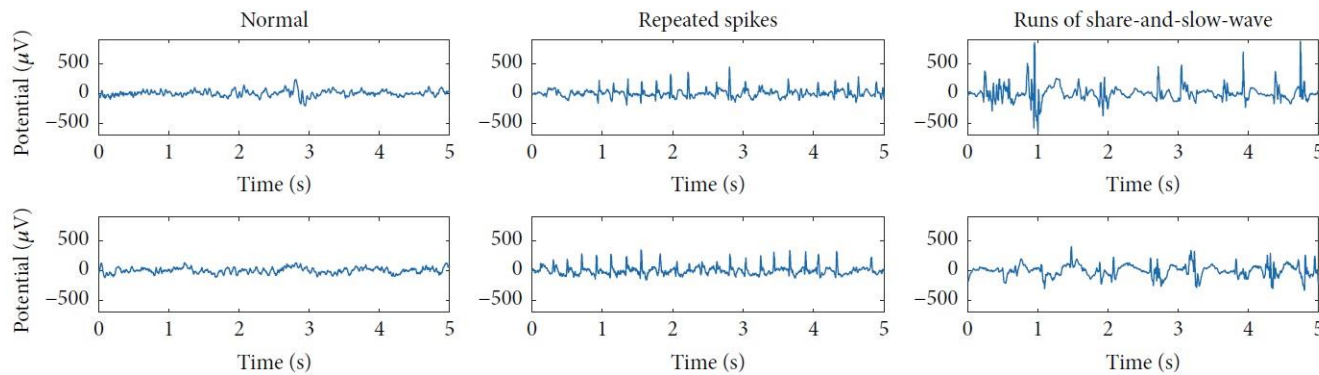


$$x(t) = \sum_{n=1}^N A_n \sin(2\pi f_n t + \phi_n)$$

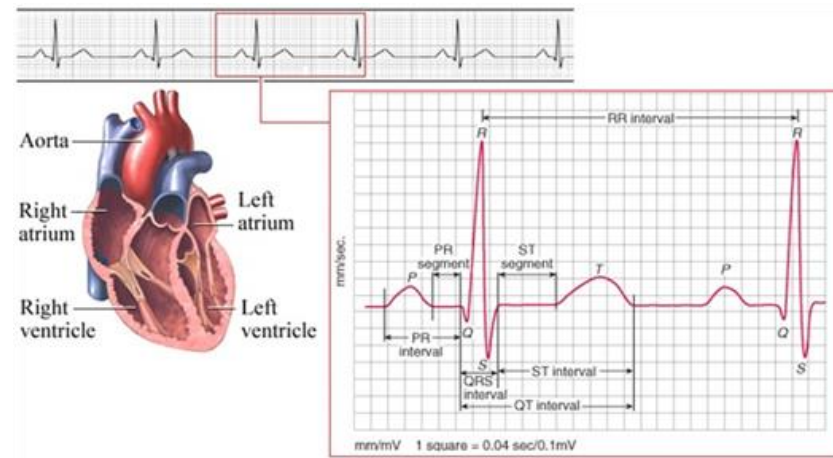
Biosignals



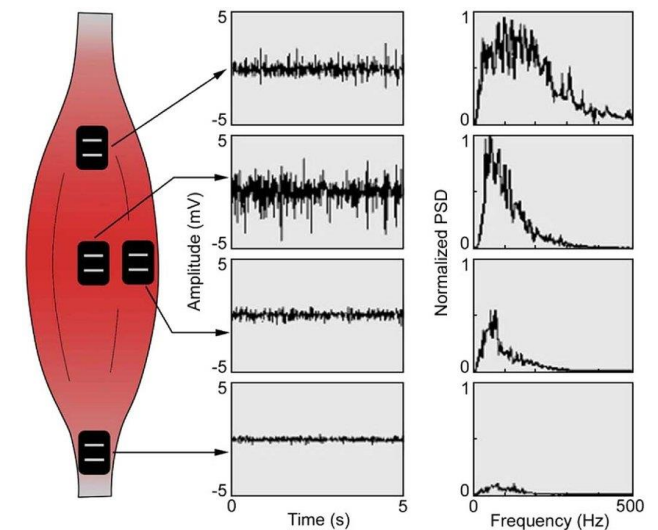
EEG



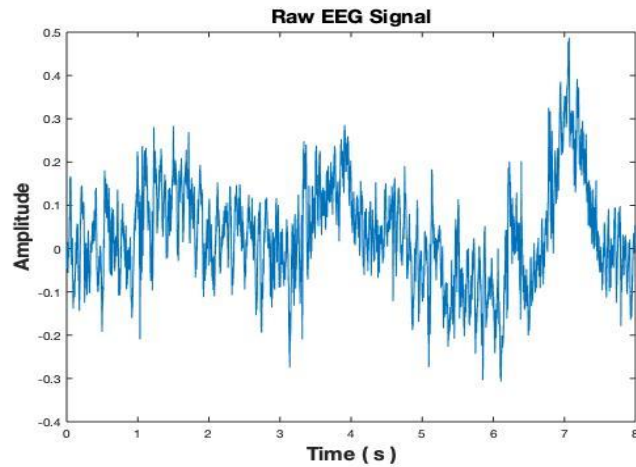
ECG/EKG



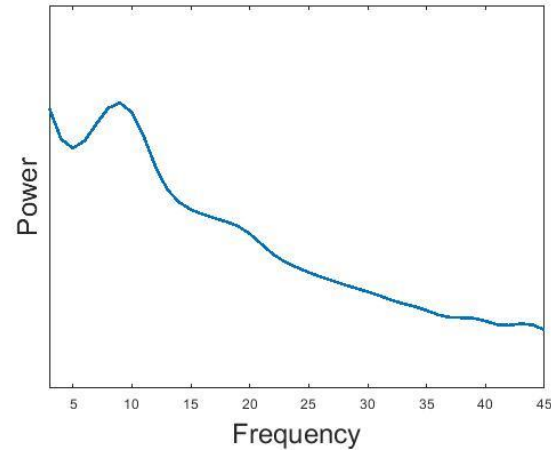
EMG



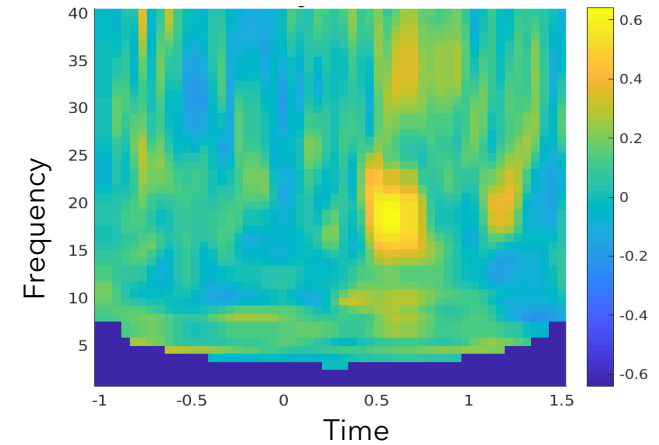
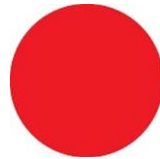
Signal Characteristics



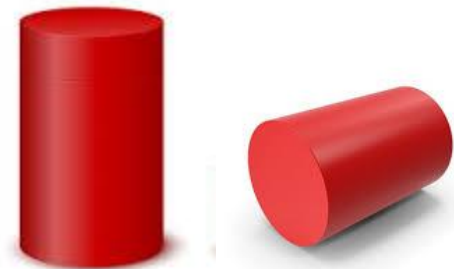
Time-domain



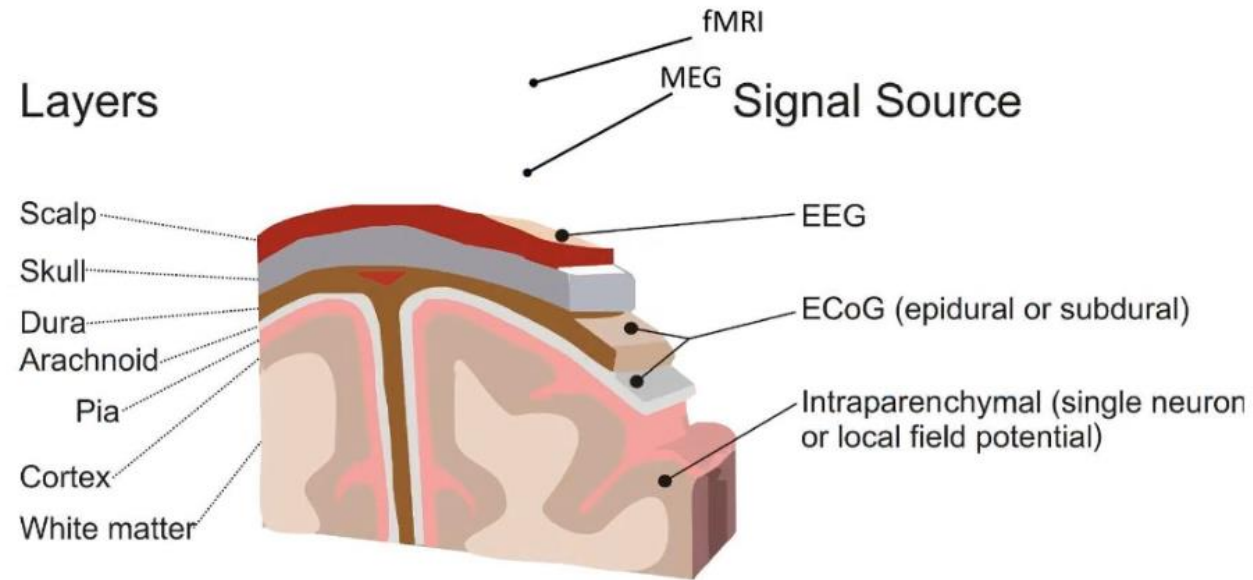
Frequency-domain



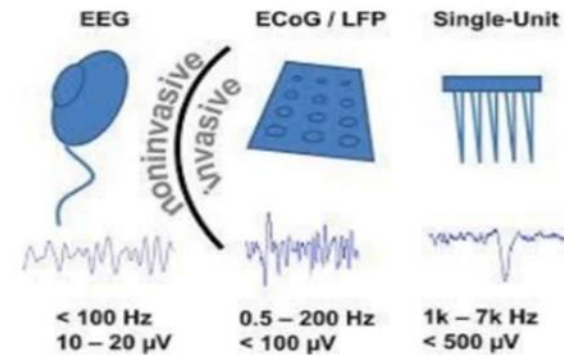
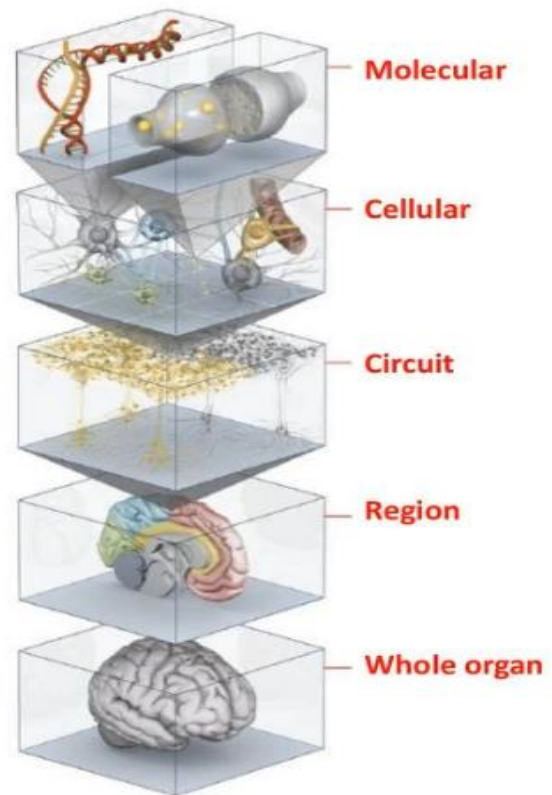
Time-frequency domain



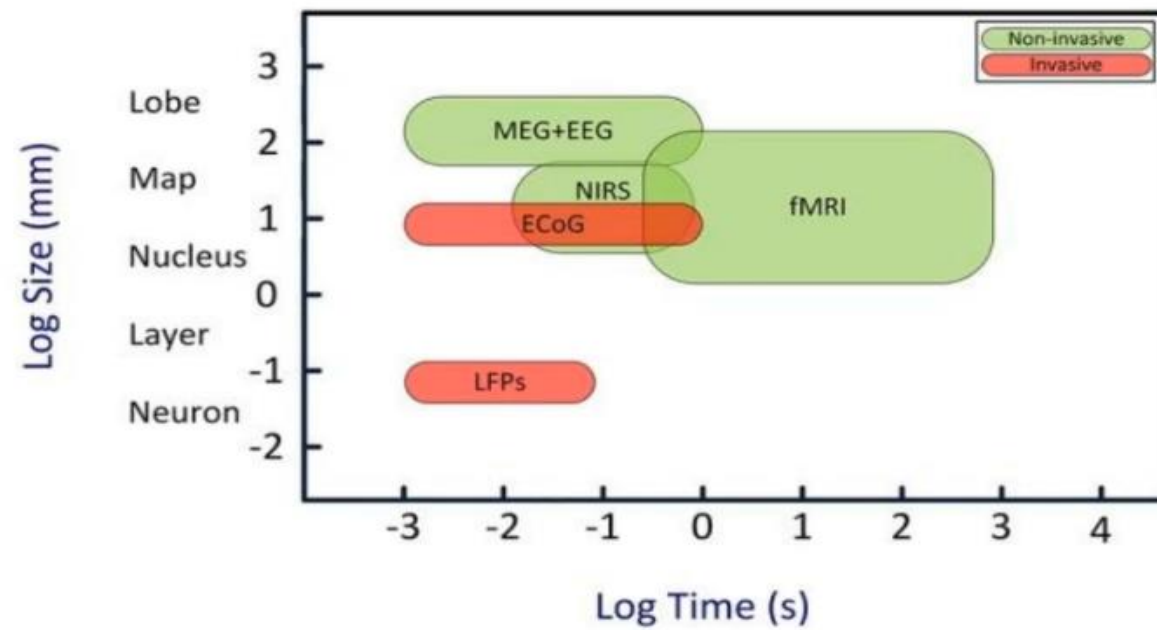
Brain Signal Recording



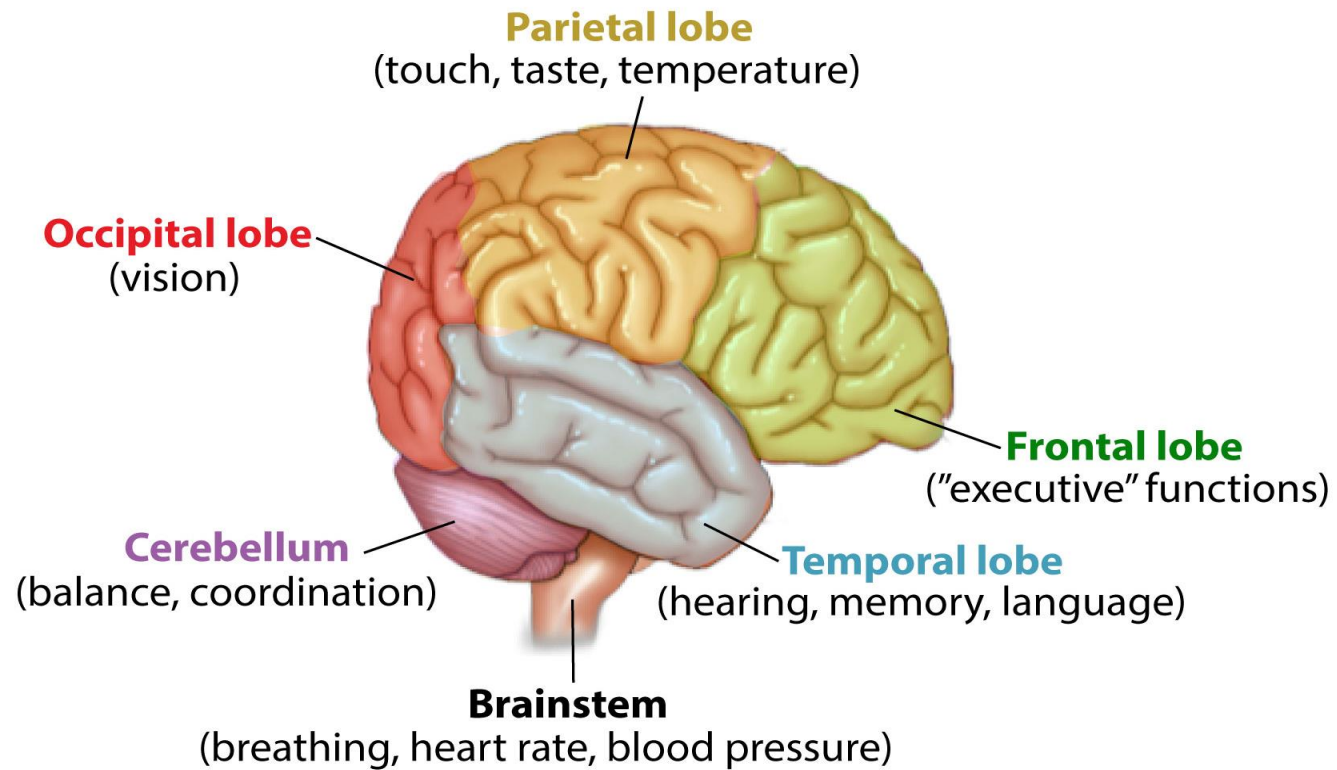
Brain Signal Recording



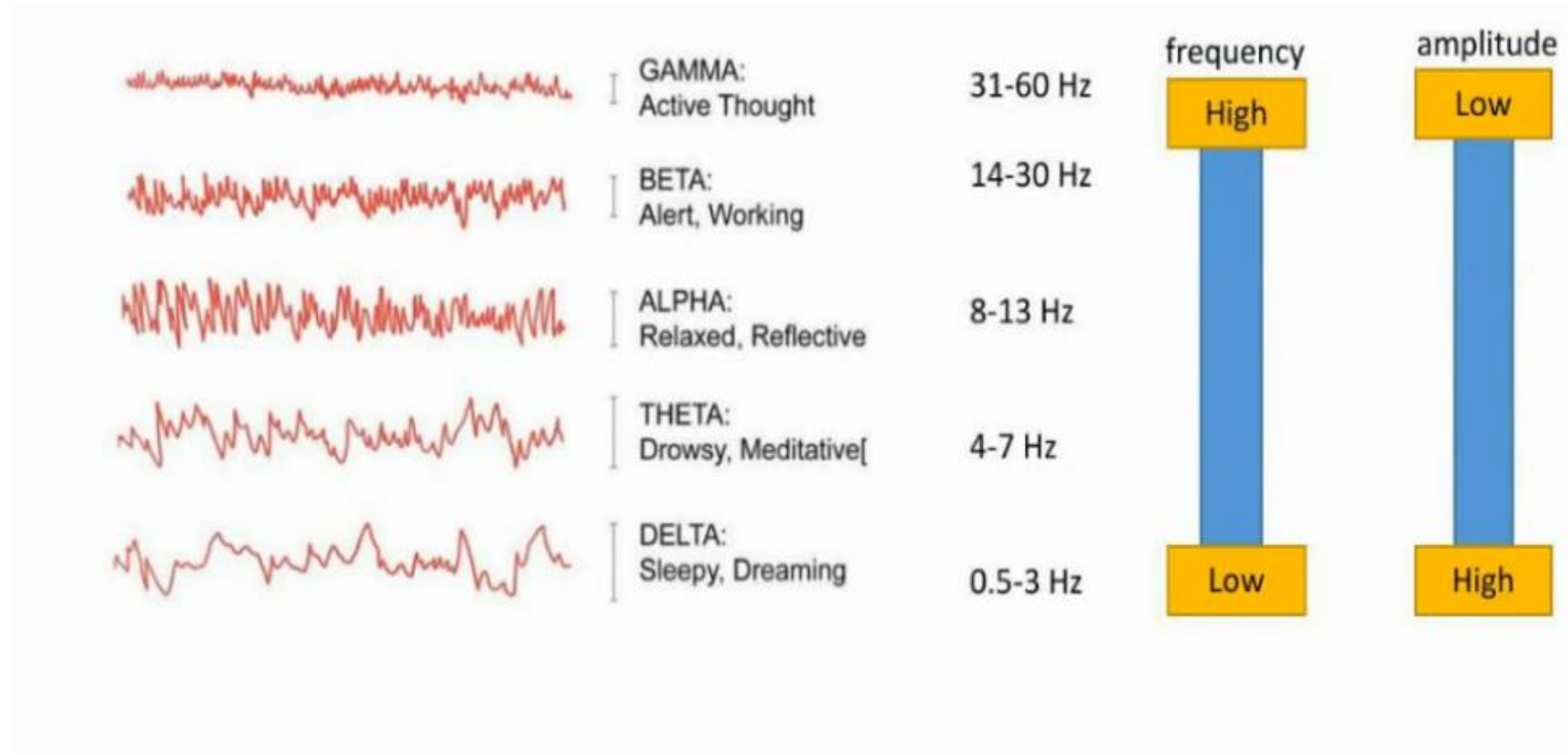
Brain Signal Recording



Brain Lobes

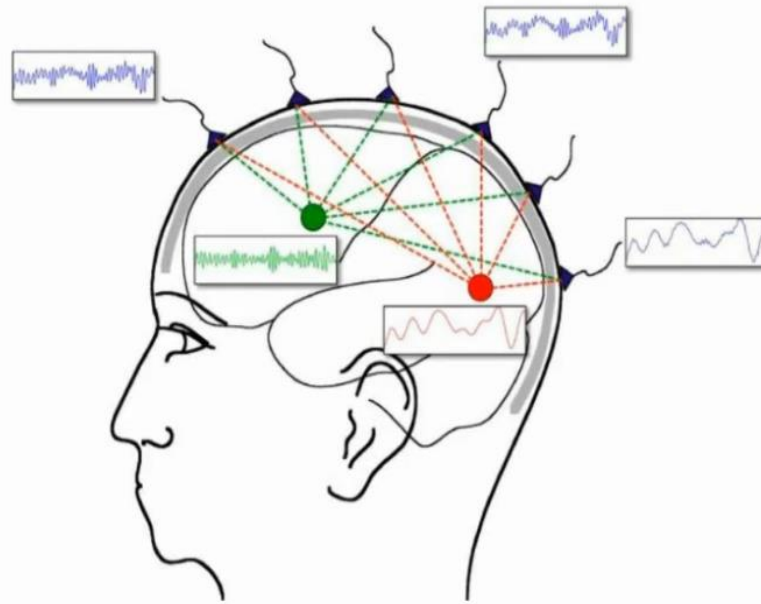


Brain Frequencies



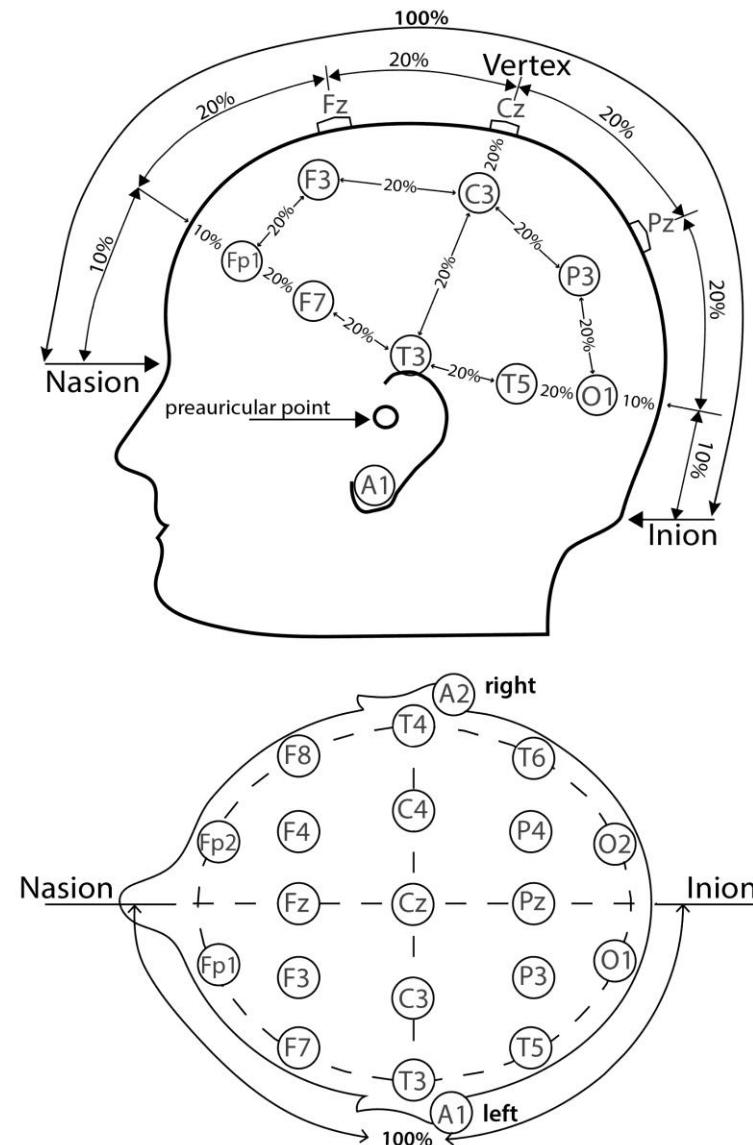
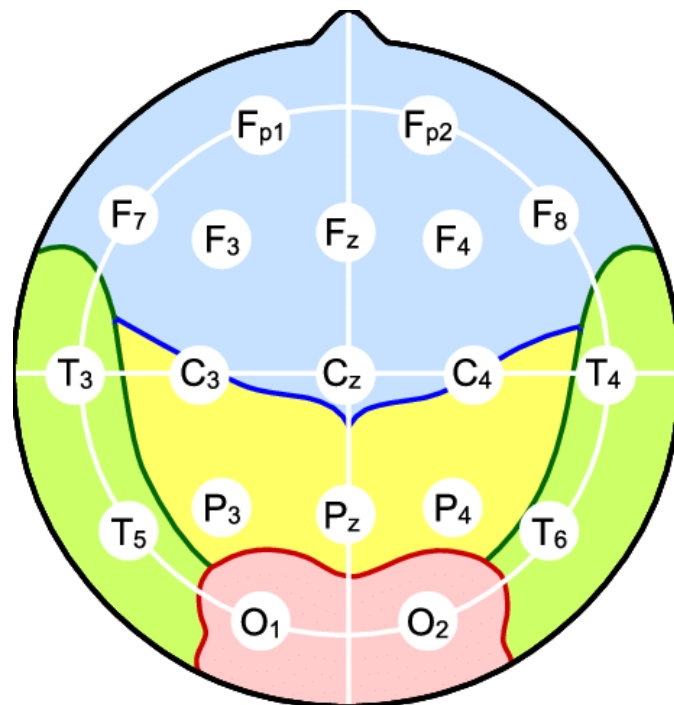
EEG

Sensor vs. Source



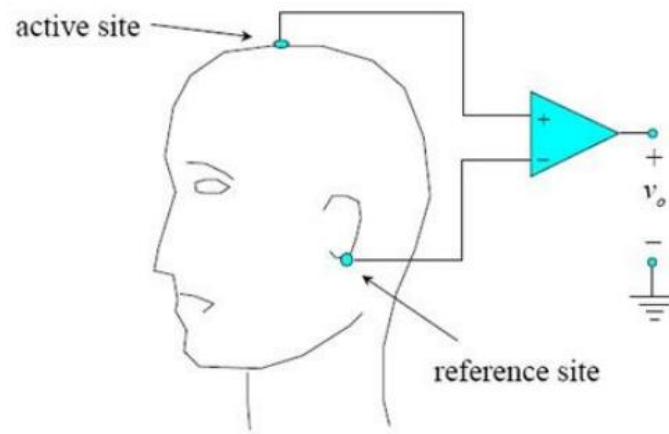
EEG

10-20 system of EEG recording

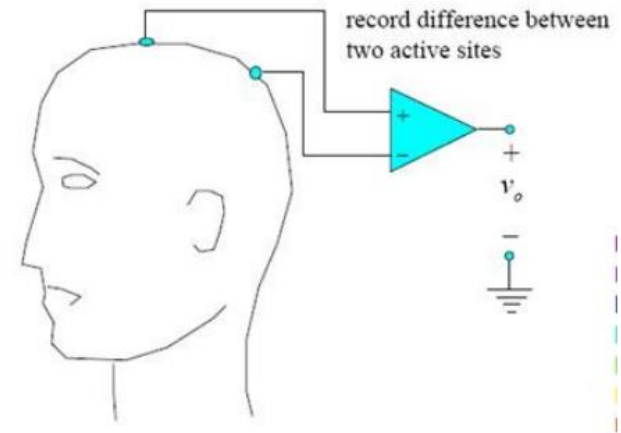


EEG

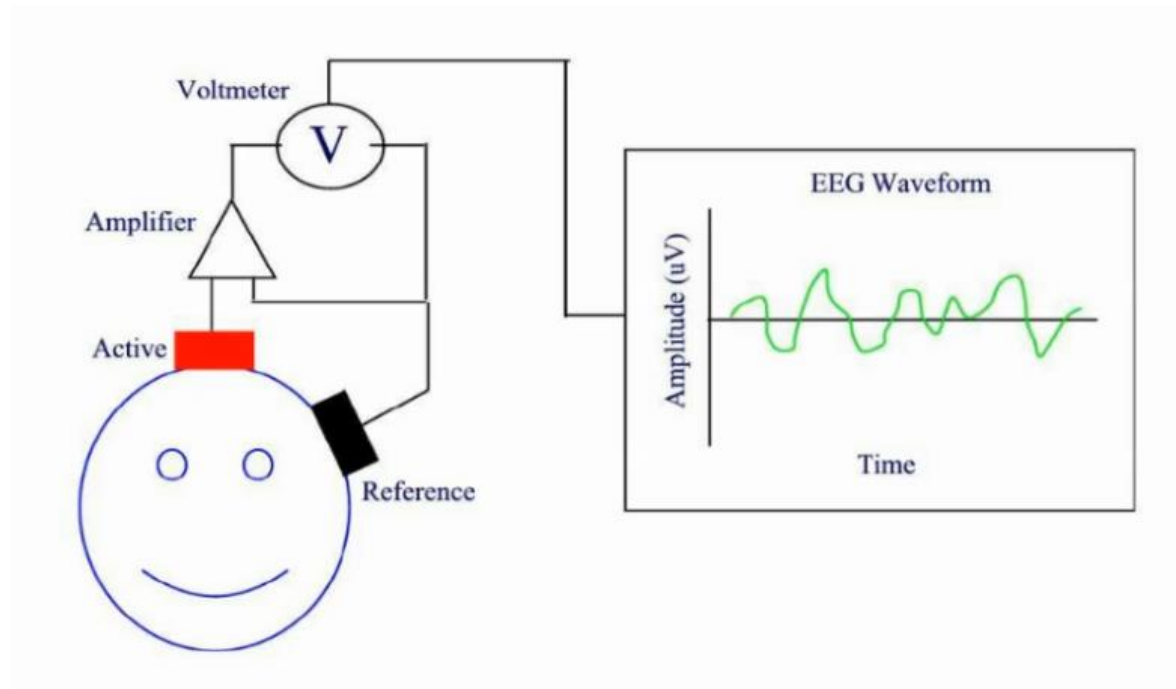
Unipolar EEG Recording



Bipolar EEG Recording

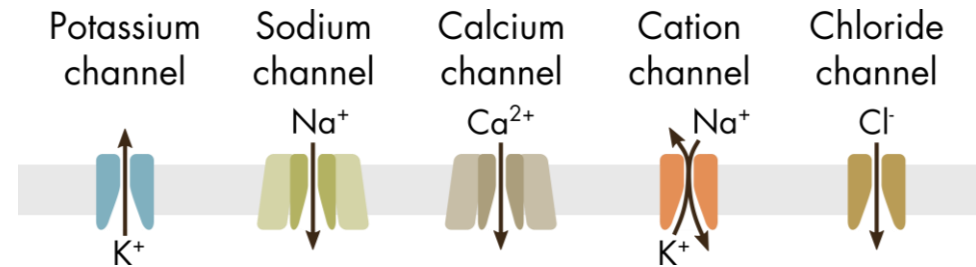
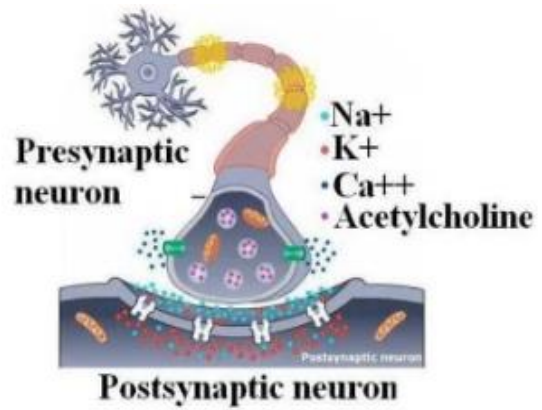


EEG



EEG

Main source of EEG signals



EEG

Frequency and Amplitude

At cranial surface

EEG amplitude \approx 0 to 100 μ V

EEG frequency \approx 0.5 to 100 Hz

Effective Factors

- Age
- Fatigue (level of consciousness)
- Level of blood oxygen, glucose, ...
- Mind state (mental effort)
- ...

EEG

Sources of EEG noise and artifacts

- **Nonphysiologic**

- Electrodes
- Headbox
- Amplifier
- Cable
- Environment
- Laptop and electronic devices
- Intravenous Fluids drip
- Respirator
- Phone ringing
- Bed/patient movements

- **Physiologic**

- Respiration artifact
- Eye blinks
- Eye movements
- ECG
- EMG
- Glossokinetic

EEGLAB



EEGLAB

What is EEGLAB?

Requirements

Download

Documentation - Wiki

Workshops - Wiki

Tutorial - Wiki

EEGLAB News

EEGLAB Workshop

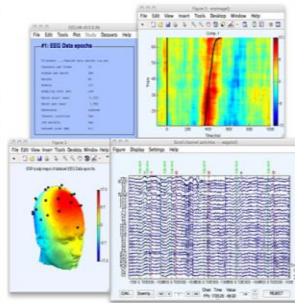
EEGLAB Workshop 2025 will be held from November 21 –

What is EEGLAB?



EEGLAB is an interactive Matlab toolbox for processing continuous and event-related EEG, MEG and other electrophysiological data incorporating independent component analysis (ICA), time/frequency analysis, artifact rejection, event-related statistics, and several useful modes of visualization of the averaged and single-trial data. EEGLAB runs under Linux, Unix, Windows, and Mac OS X.

EEGLAB provides an interactive graphic user interface (GUI) allowing users to flexibly and interactively process their high-density EEG and other dynamic brain data using independent component analysis (ICA) and/or time/frequency analysis (TFA), as well as standard averaging methods. EEGLAB also incorporates extensive tutorial and help windows, plus a command history function that eases users' transition from GUI-based data exploration to building and running batch or custom data analysis scripts. EEGLAB offers a wealth of methods for visualizing and modeling event-related brain dynamics, both at the level of individual EEGLAB 'datasets' and/or across a collection of datasets brought together in an EEGLAB



<https://sccn.ucsd.edu/eeglab/>

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