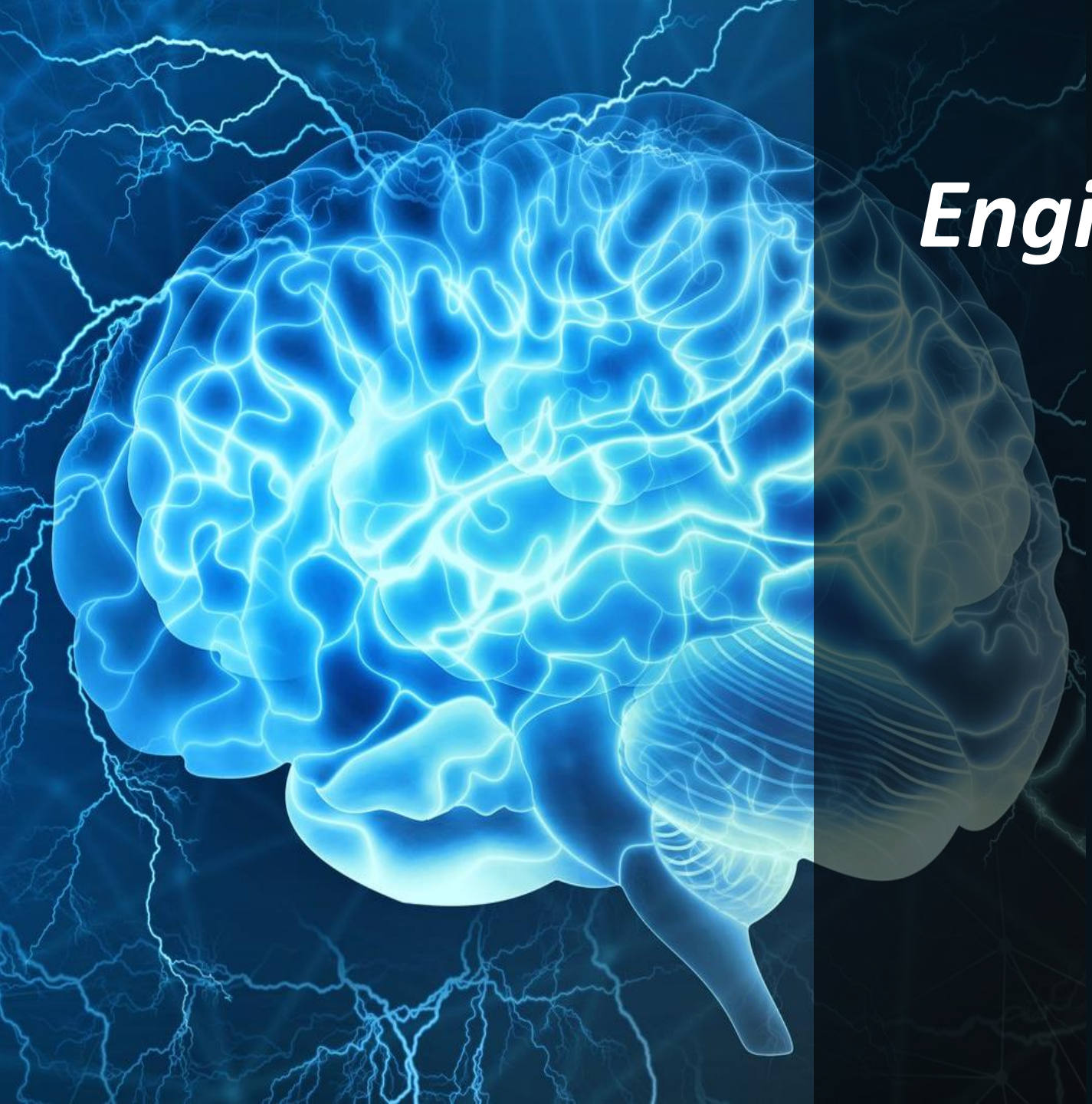


Neural Engineering Team Week.2

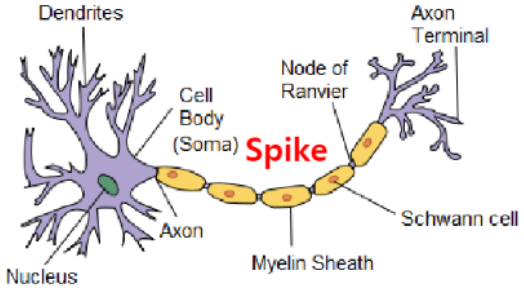
2022.09.23 6pm

Lee Seong Jin

Neural Origin of EEG

Action Potential

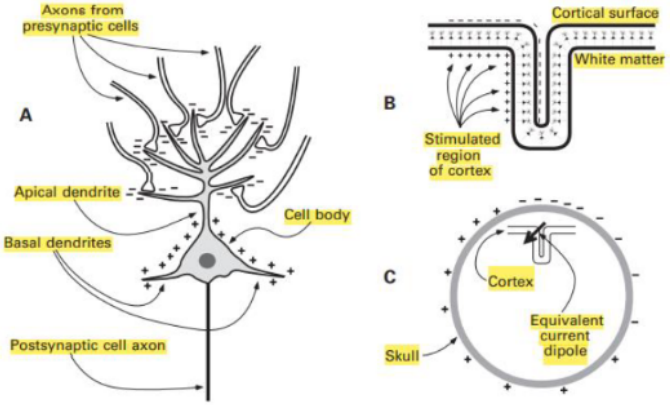
Rising and falling in membrane potential across a axon



일반적으로 많은 수의 Neuron이 정확히 같은 시간에 Spike 발생 X
→ Action Potential은 Scalp에서 기록되기 어려움

PSP(PostSynapticPotential)

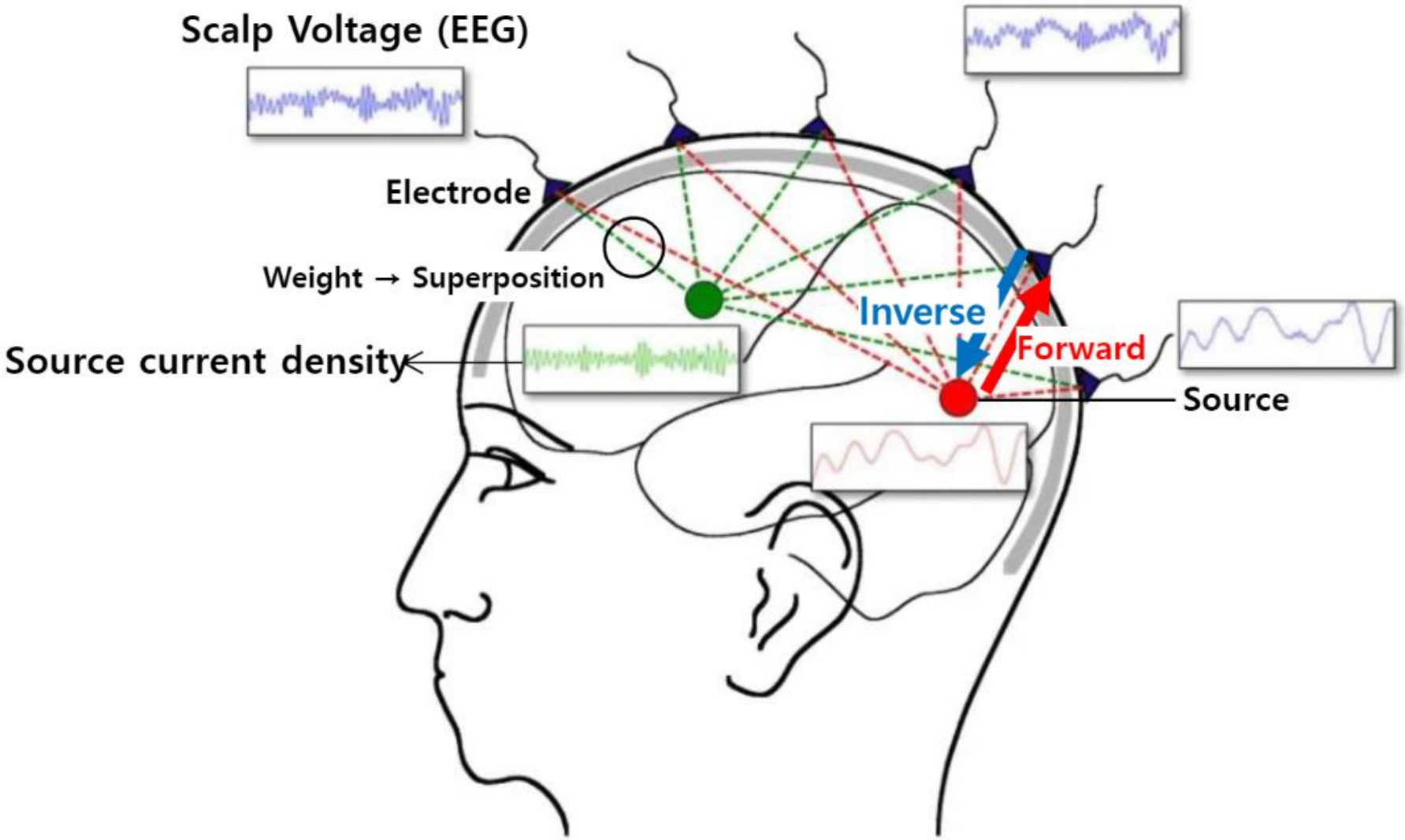
① Neurotransmitters bind to receptors on the membrane of the postsynaptic cell
② Ion channels open or close → Voltage across the membrane



ERP is almost always reflect PSP

Neurotransmitter : Excitatory / Inhibitory
Synapse : Cellbody / Apical dendrite / Basal dendrite
Site transmits signals from presynaptic cell to postsynaptic cell
Equivalent current dipole = Sum of unit dipoles
Single functional brain region

EEG generation

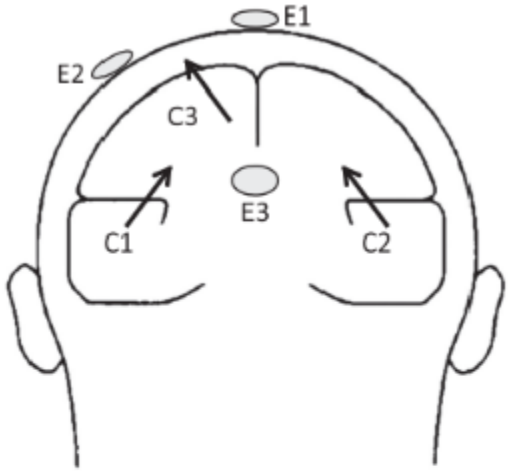


Superposition

EEG : waveform mixed up several source of brain activity

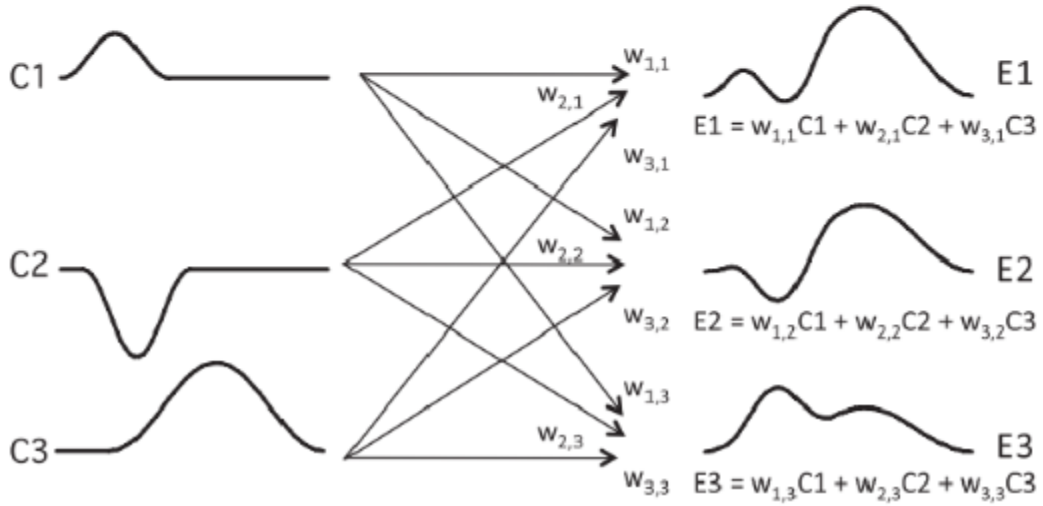
Hypothetical weights from components to electrodes

	Electrode 1	Electrode 2	Electrode 3
Component 1	$w_{1,1} = 1$	$w_{1,2} = 0.25$	$w_{1,2} = 0.5$
Component 2	$w_{2,1} = 0.5$	$w_{2,,2} = 0.5$	$w_{2,3} = -0.5$
Component 3	$w_{3,1} = 1$	$w_{3,2} = 0.75$	$w_{3,3} = 0.5$



Source waveform at the generator location for each component

Observed waveform at each electrode site

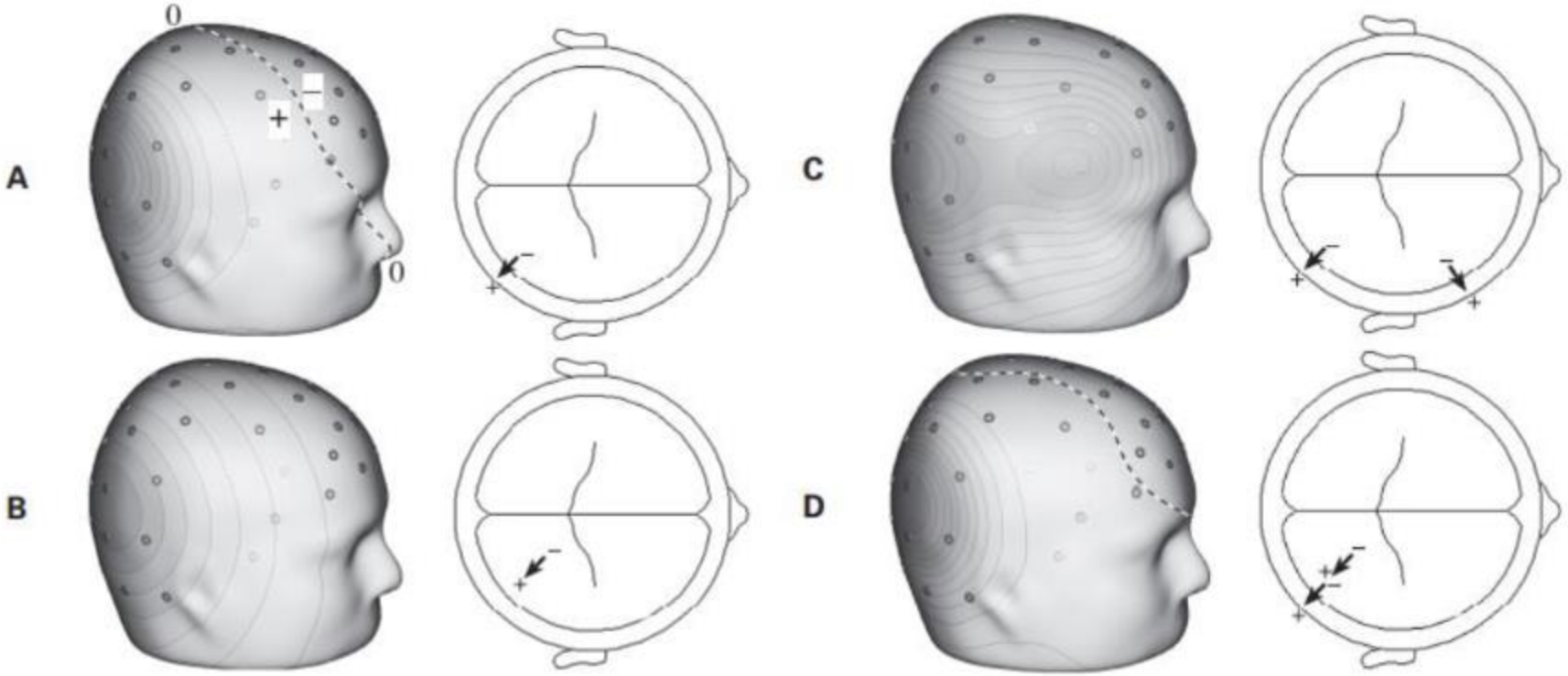


Forward / Inverse Problem

Scalp Voltage Distribution

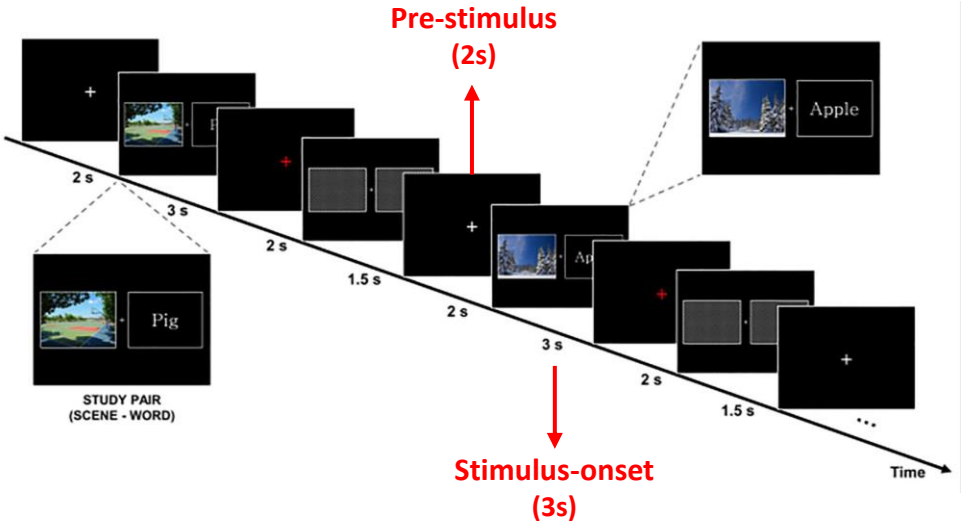
↑ ↓

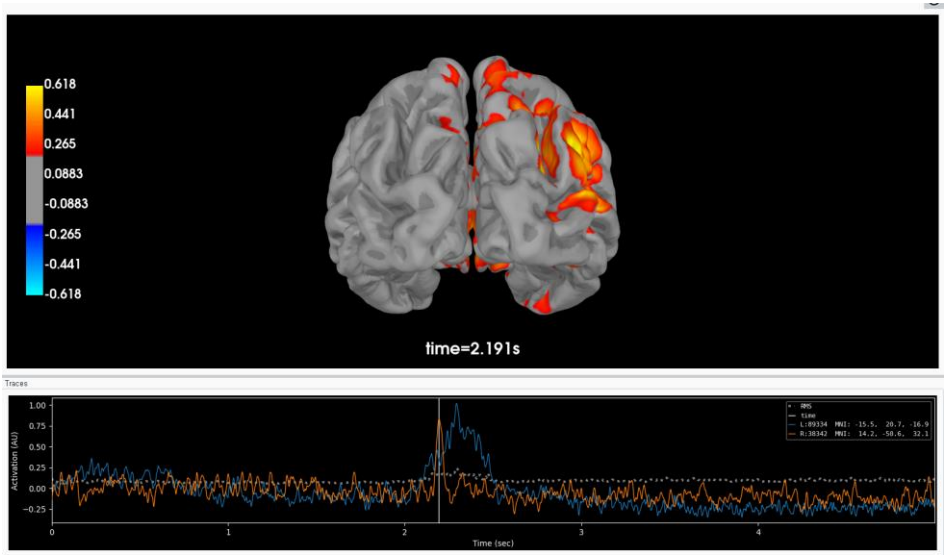
Internal underlying brain component



Source Estimation

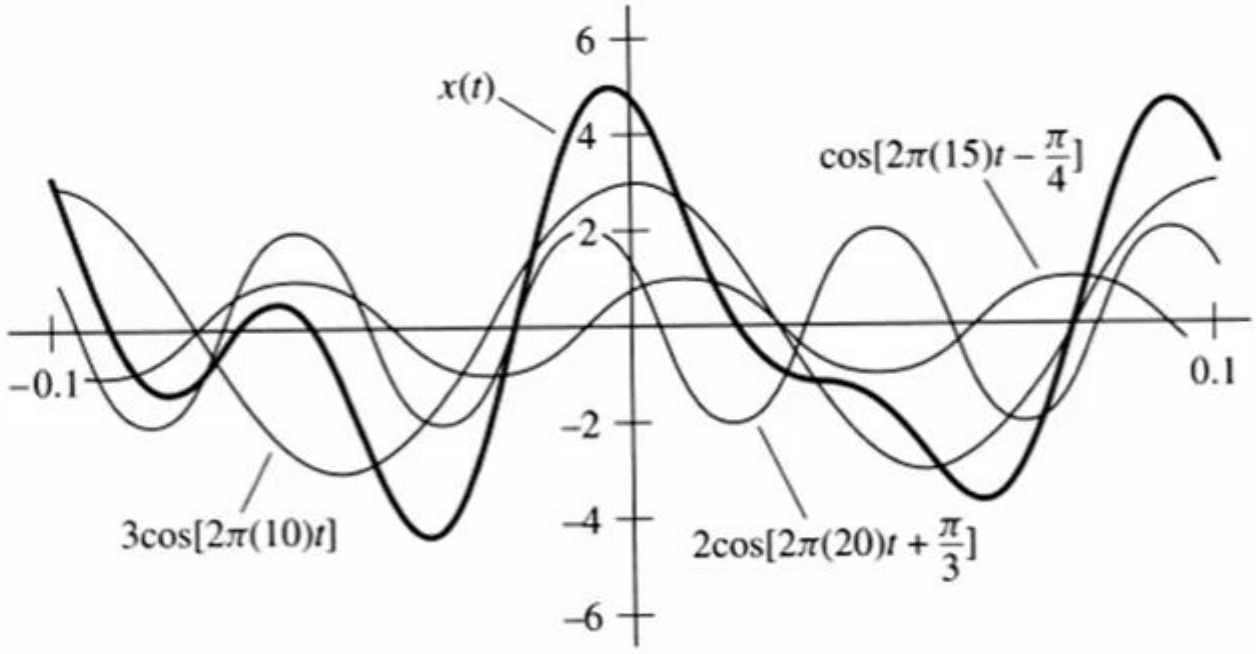
→ using MNE (python)





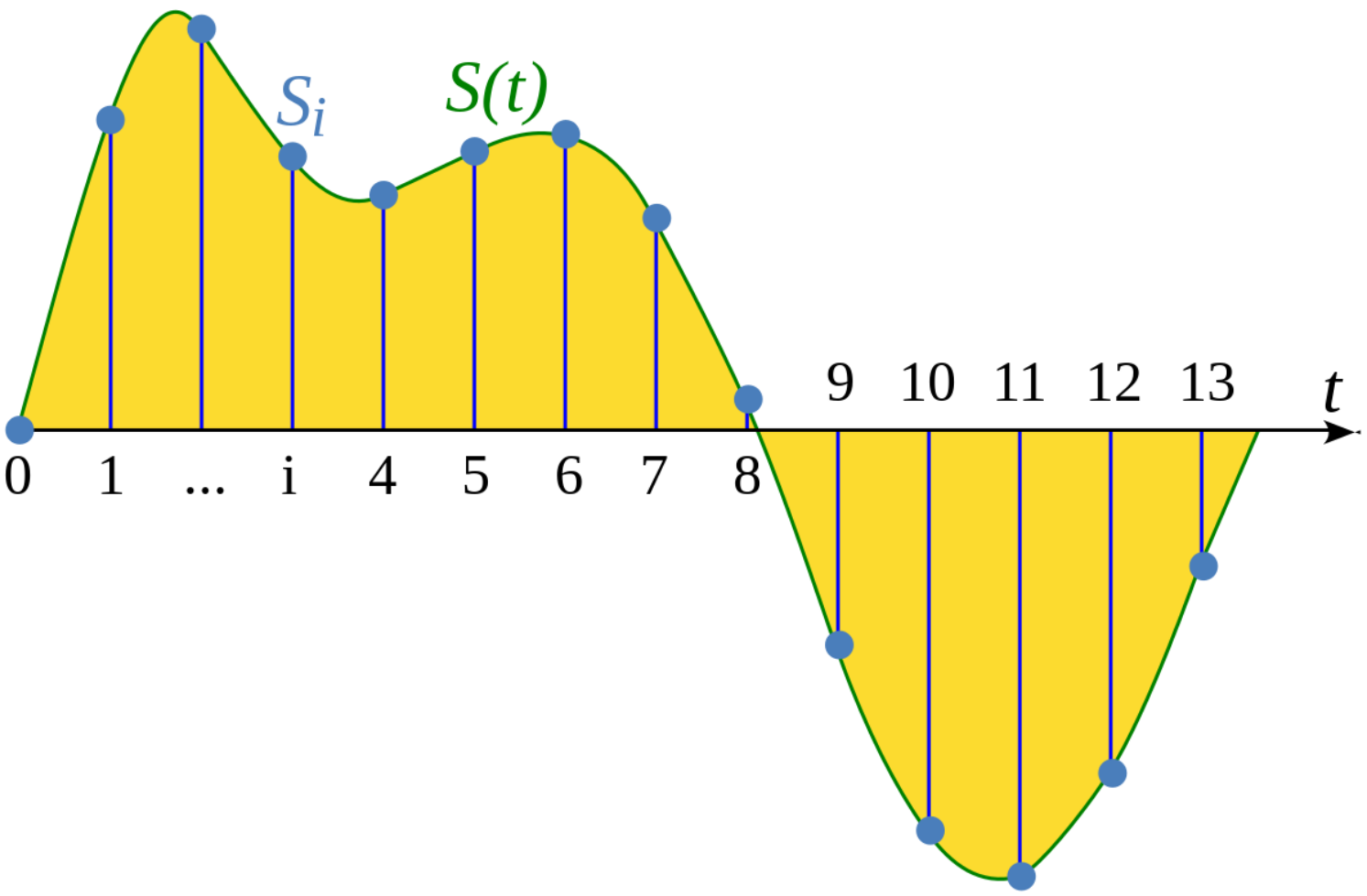
Signal? Noise?

Signal: weighted sum of sinusoids

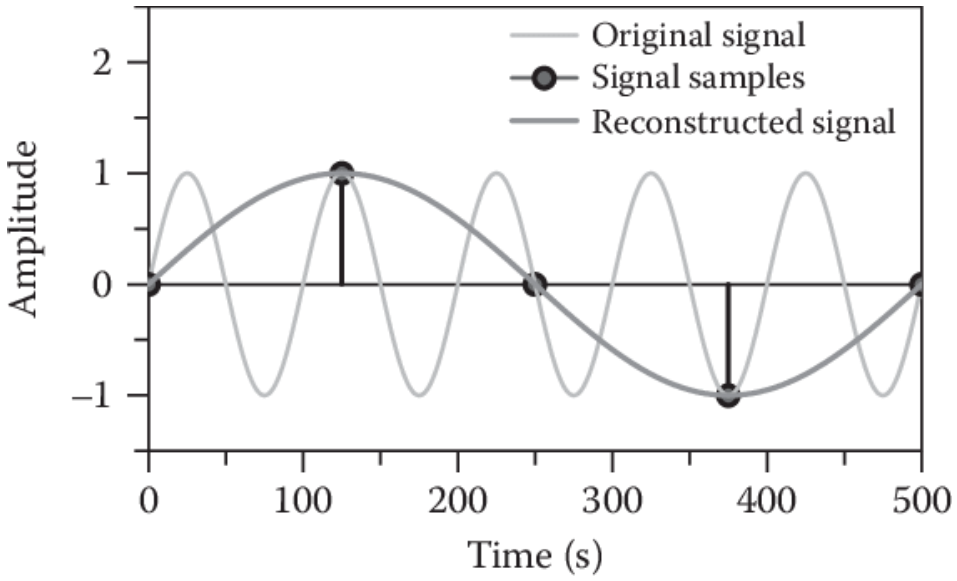


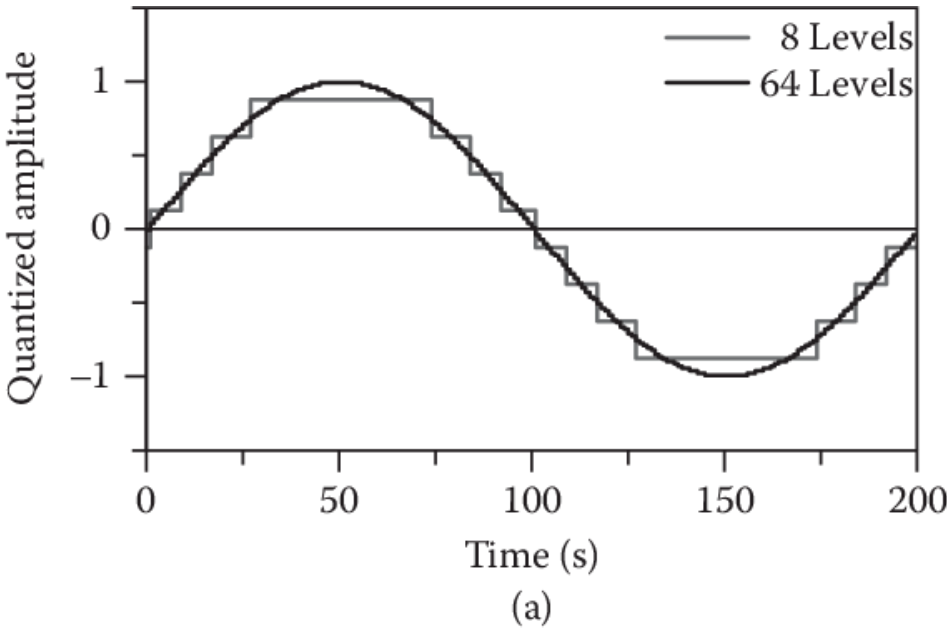
(a) Signal Waveform

Analog & Discrete



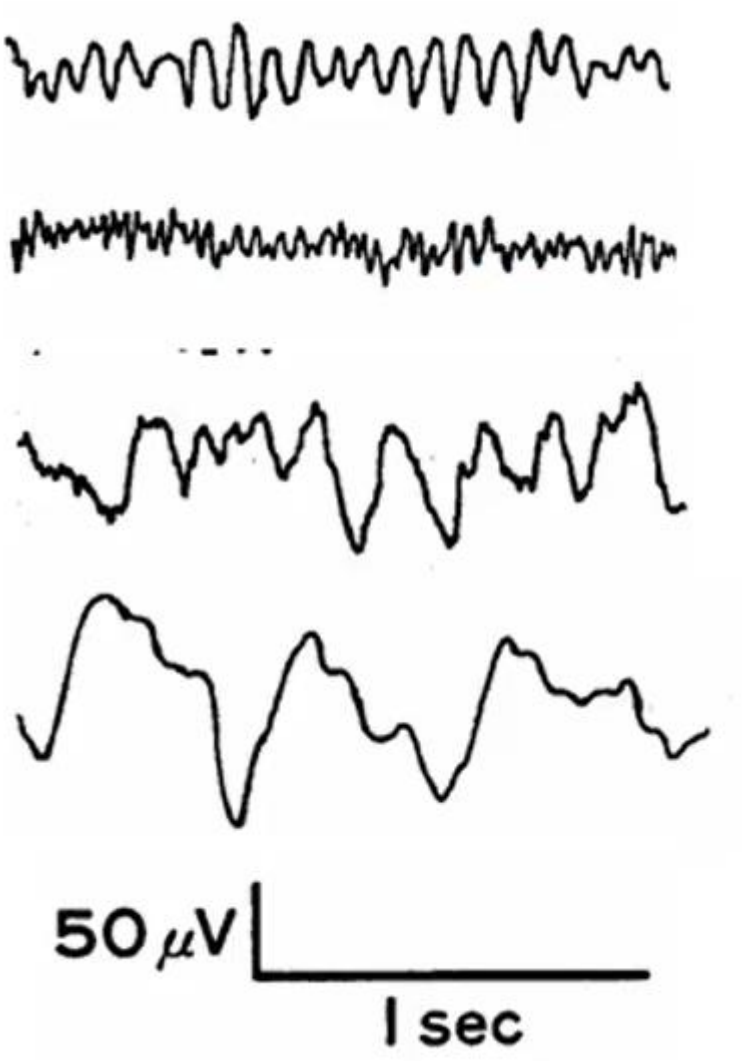
Analog & Discrete





Sampling frequency : 1s를 몇 개의 point로 sampling 했냐?

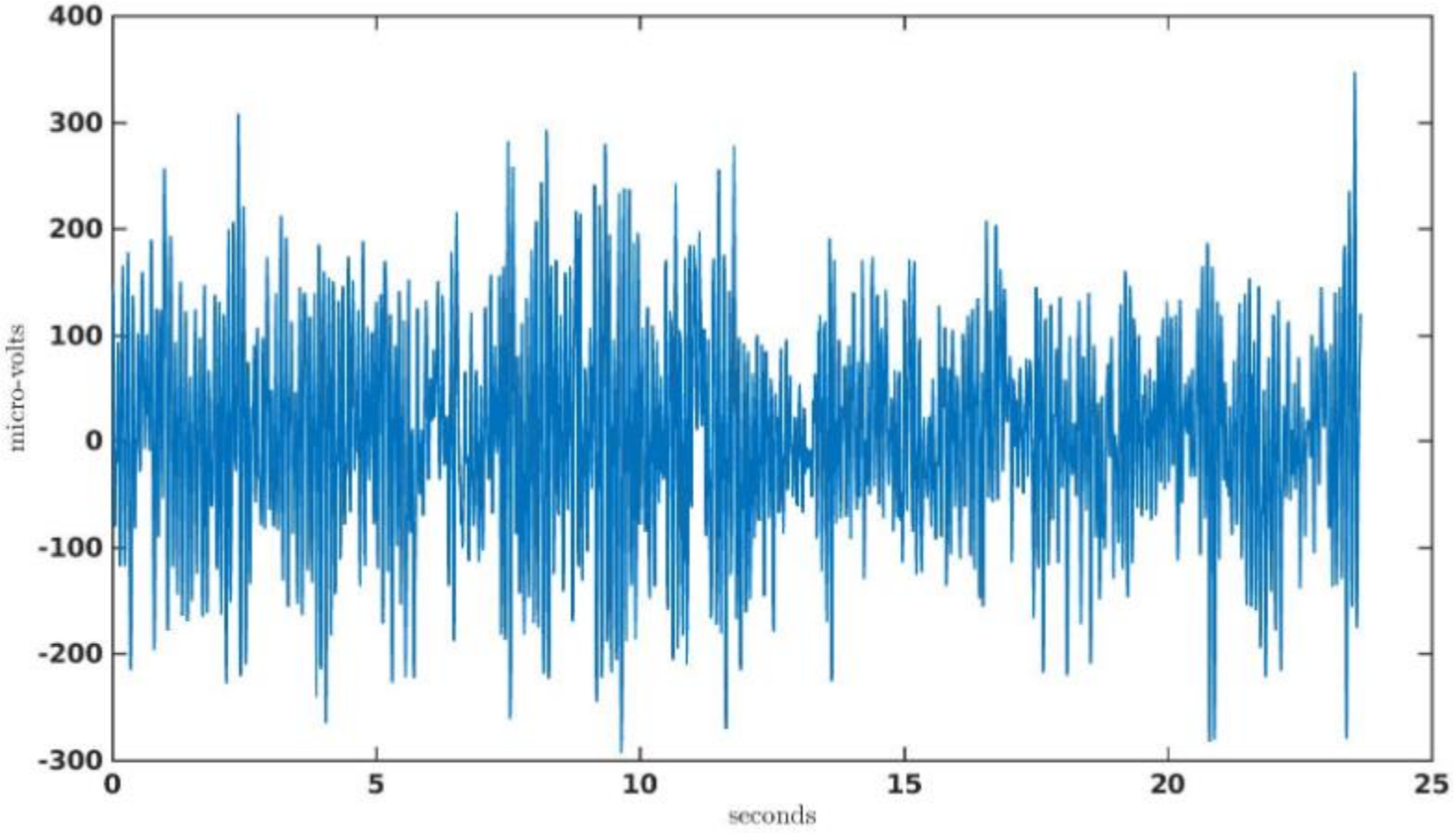
EEG division by Frequency



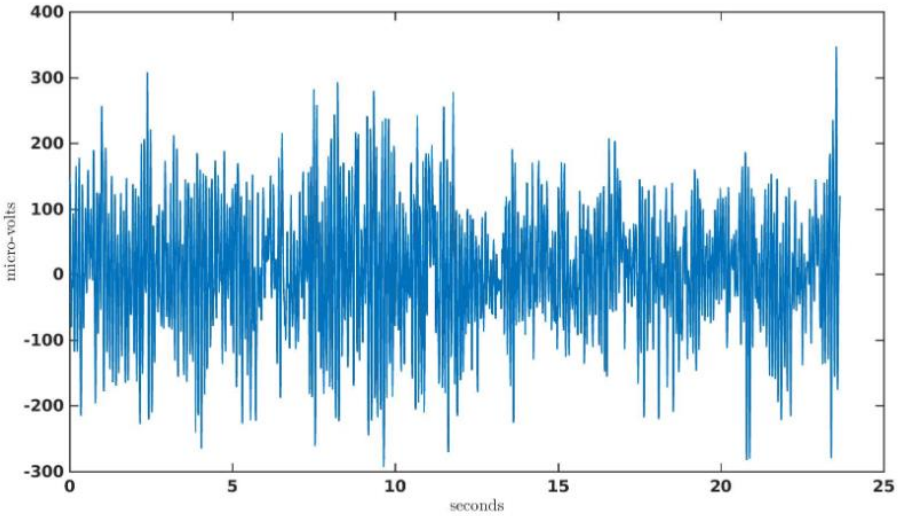
- Delta: 0.5 – 3 Hz
- Theta: 4 – 7 Hz
- Alpha: 8 – 13 Hz
- Beta: 14 – 30 Hz

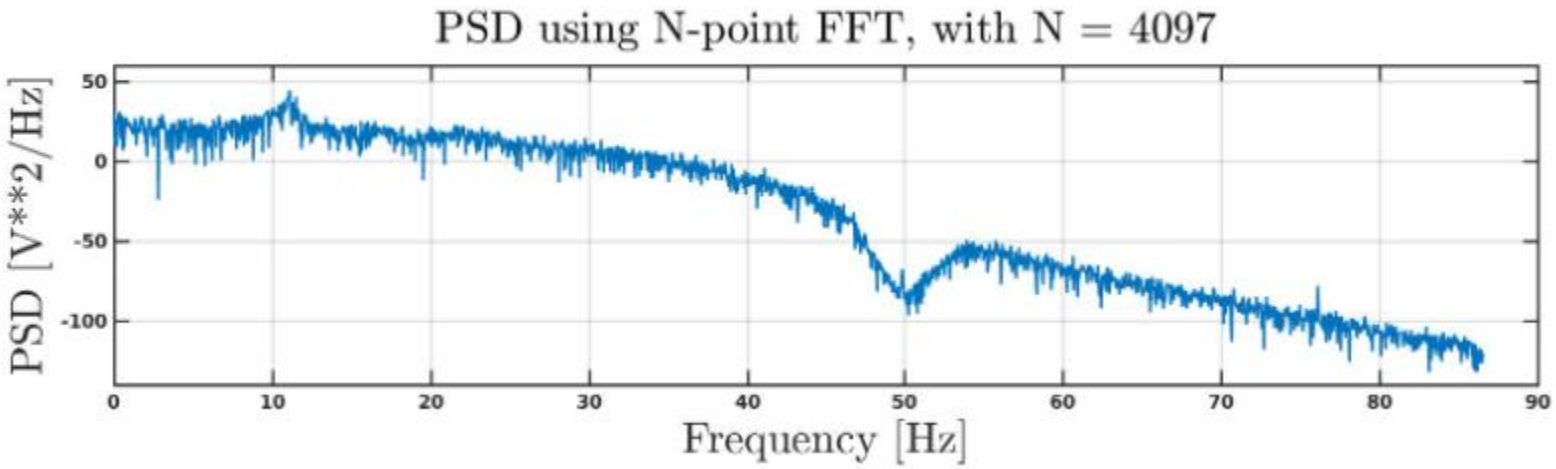
- Gamma: 30 Hz 이상 (50/80/100 Hz...)

Example of EEG

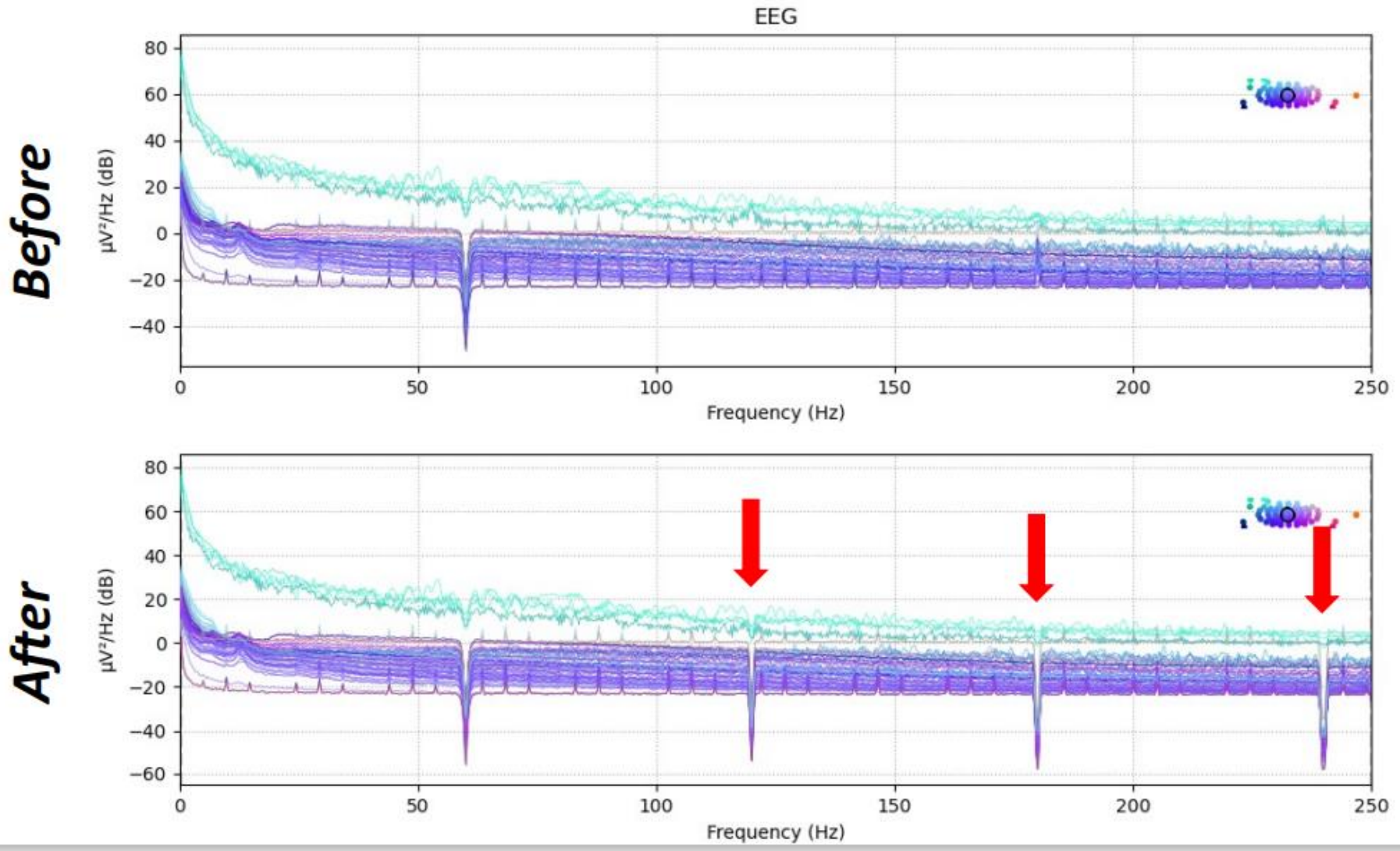


EEG in Frequency domain





Notch Filtering (Band-Stop)



Artifacts Removing

Eye-blink, EOG, EMG (Muscle movement) etc,,,

- Decomposing RAW EEG signals: noise components, EEG components
- **Removing noise components** then remixing them!