Analysis and Classification of EEG Data

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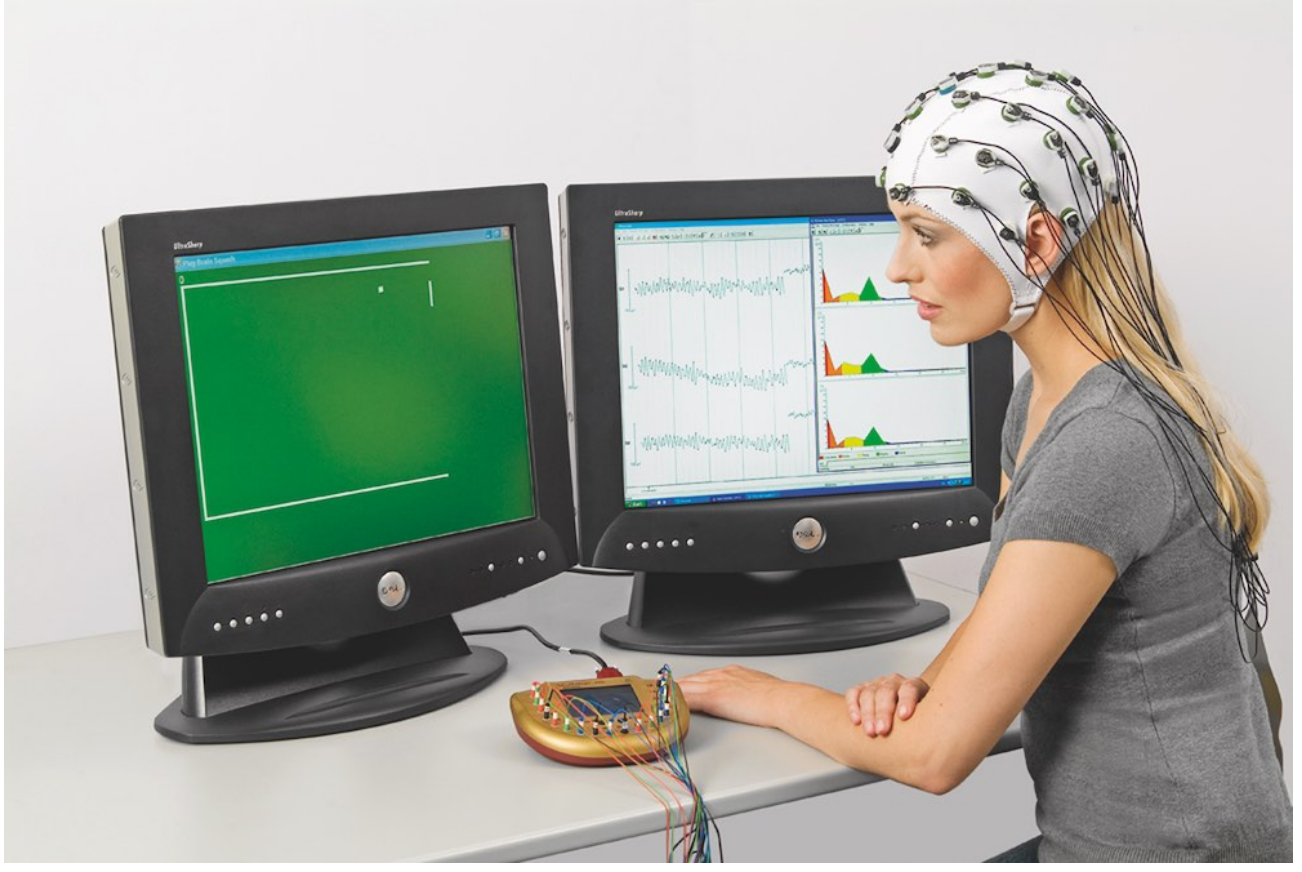
Outline

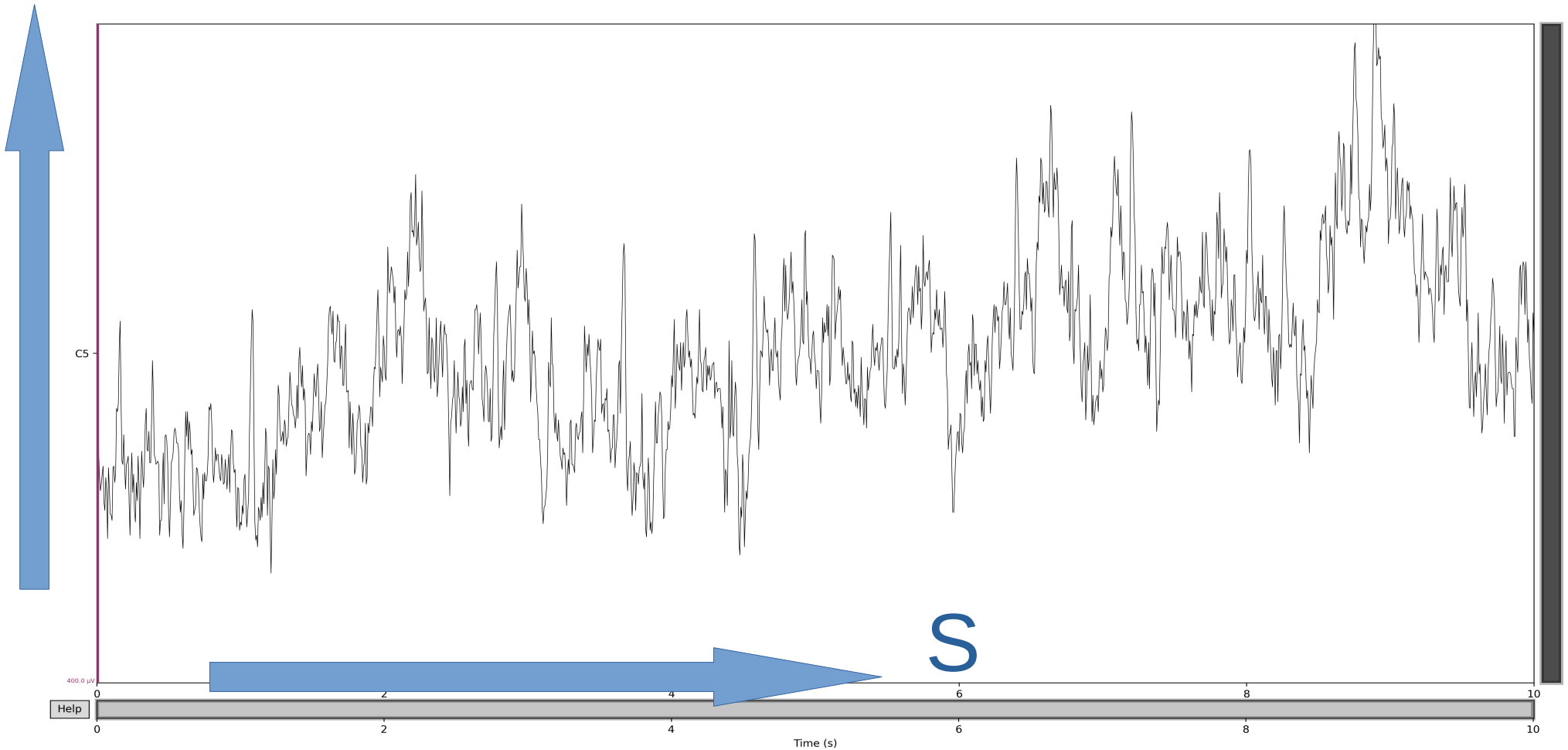
- Introduction to electroencephalography (EEG)
- Data presentation
- Preprocessing and Analysis of EEG Data
- Machine Learning and Deep Learning classification

Electroencephalography

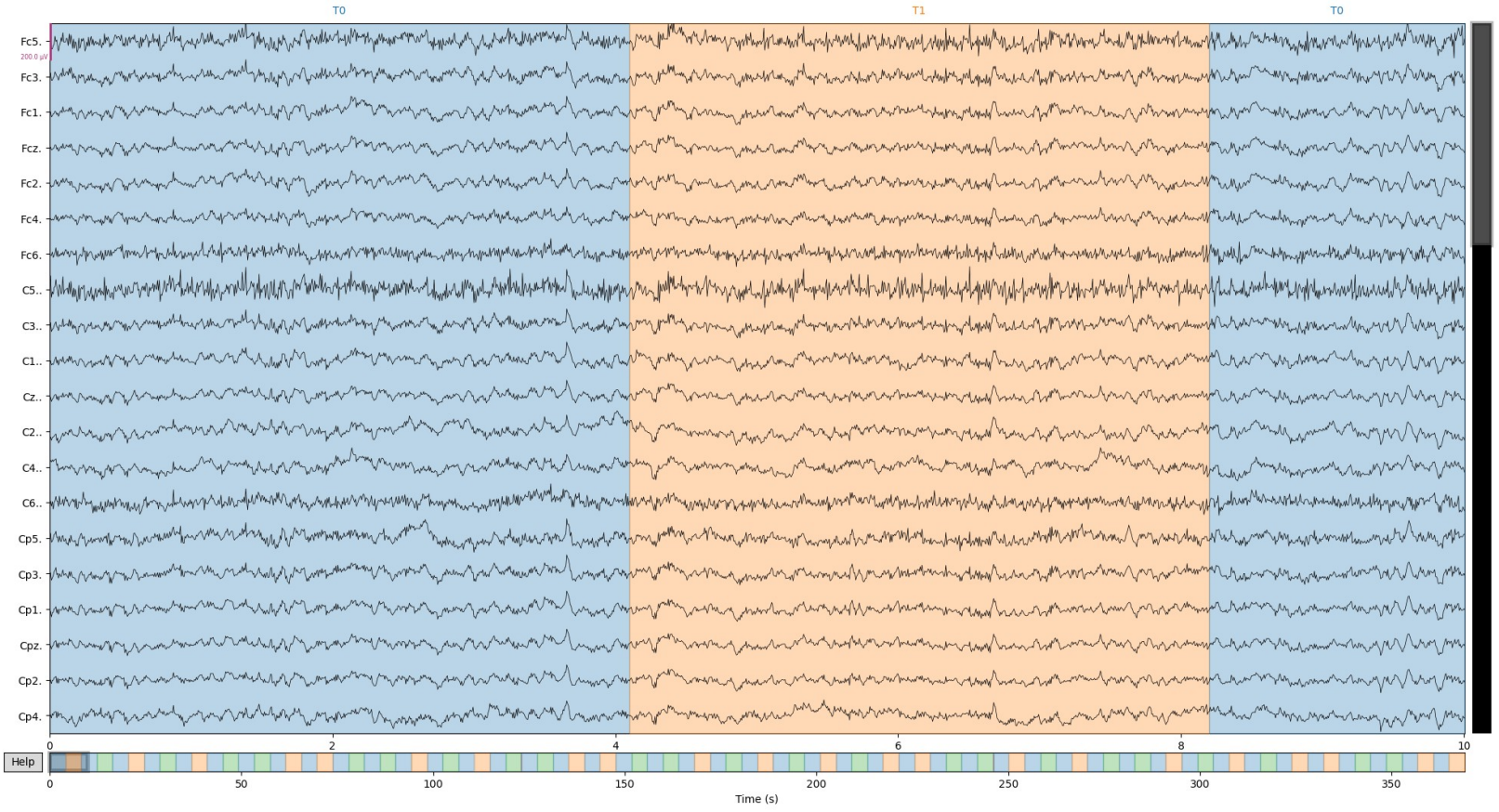


μV

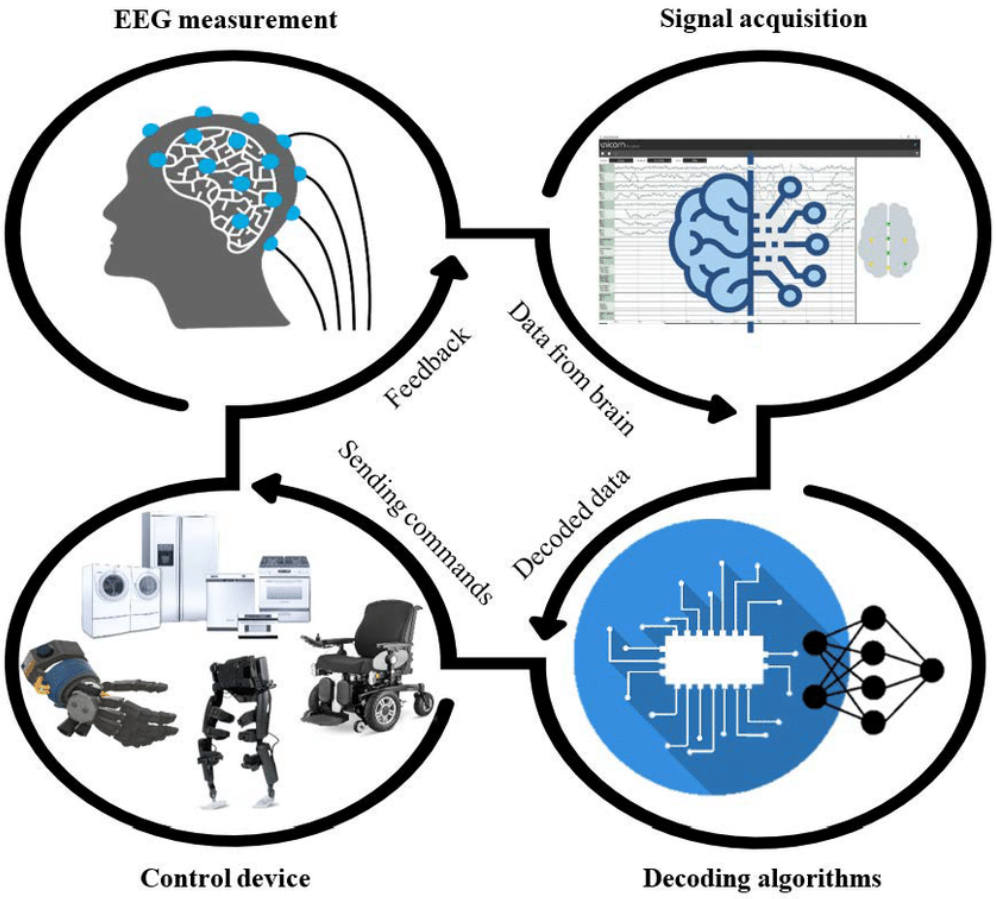
Electroencephalography



Electroencephalography



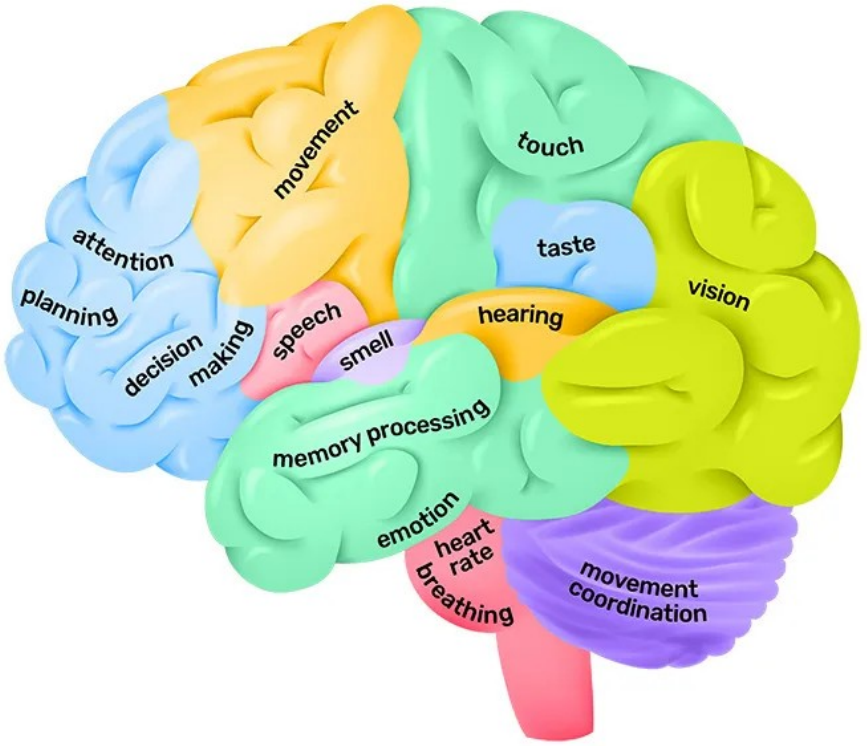
Brain-Coputer Interface



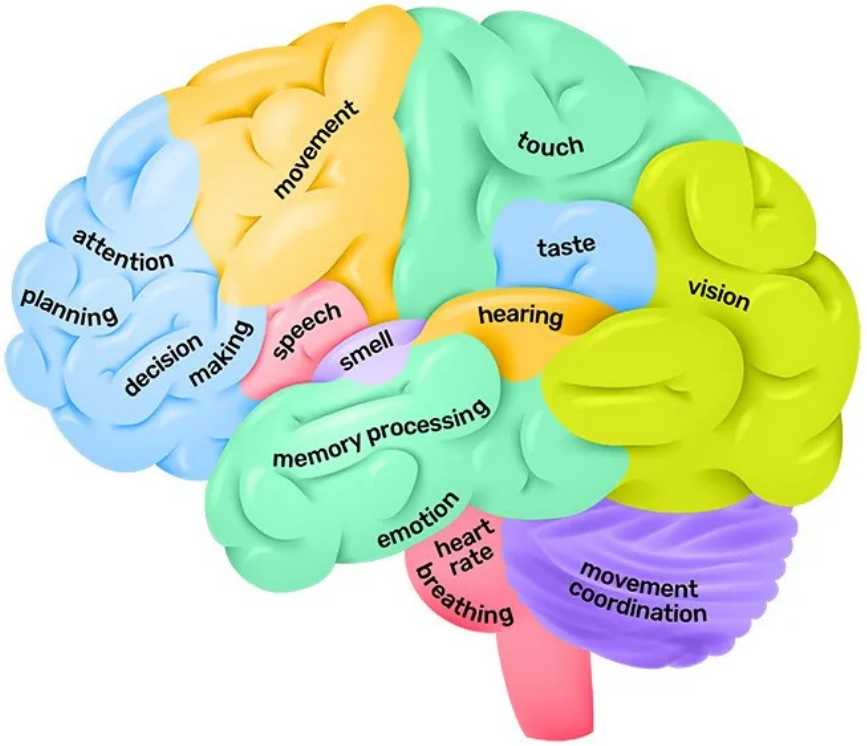
EEG signals are A BIG MESS

Every electrode records:

- Brain activity
- Muscle activity (blinks, heart beats, movments)
- Electric activity (electronic tools, power system)


movement
touch
attention
taste
vision
planning
hearing
speech
smell
decision
making
memory processing
emotion
heart
rate
breathing
movement
coordination

WE ARE ALL UNIQUE (DAMN!)



Differnet people can exhibit different brain activity patterns when performing the same task

DataSet

109 Subjects:

- 3 experiences per Subjects
- 2 minutes per experience
- 4 second visual signal: Open and close right or left fist

Objectives

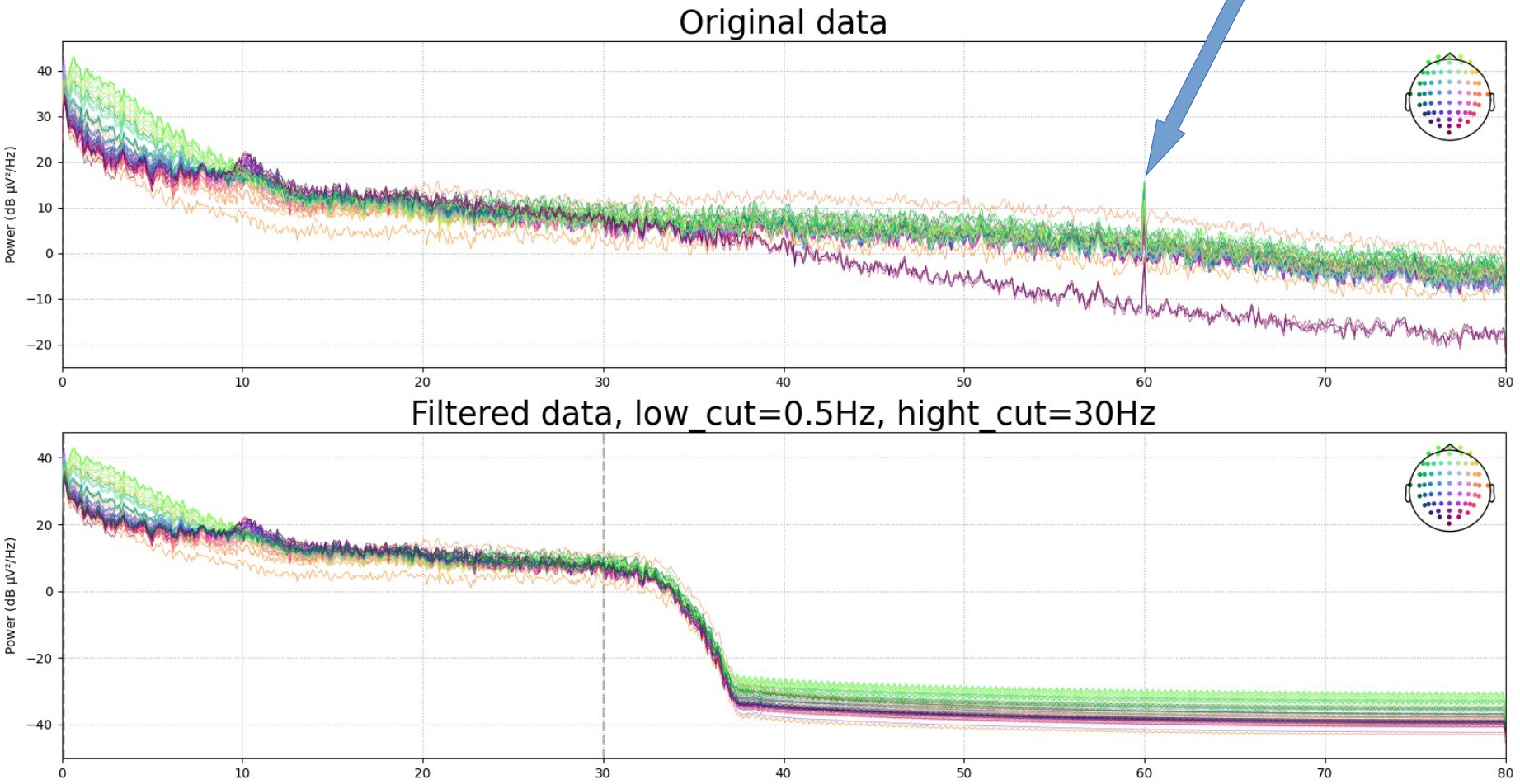
- Clean the data from the noise and recognize the movment patterns
- Implement a model that recognize the action of the subject from its EEG

Preprocessing

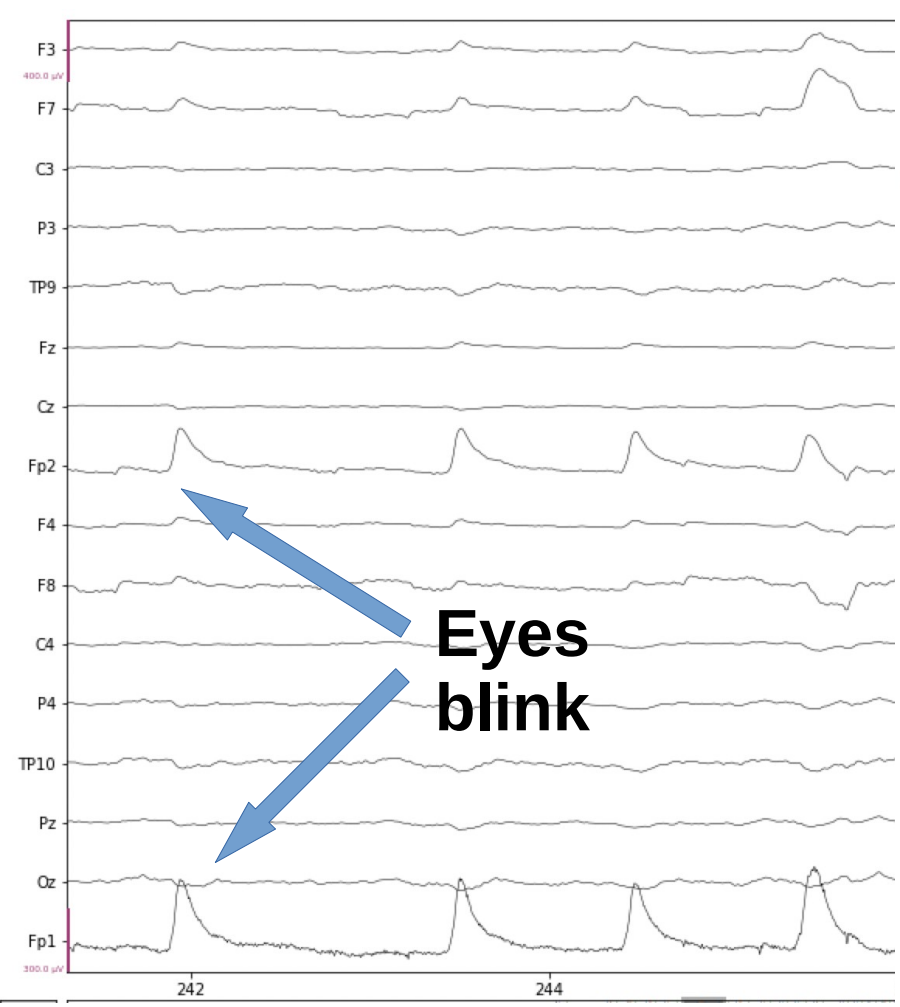
- Filter the data frequencies
- Decompose the signals and eliminate artifacts (eye blinks, and muscle movements…)
- Change the reference of the signal

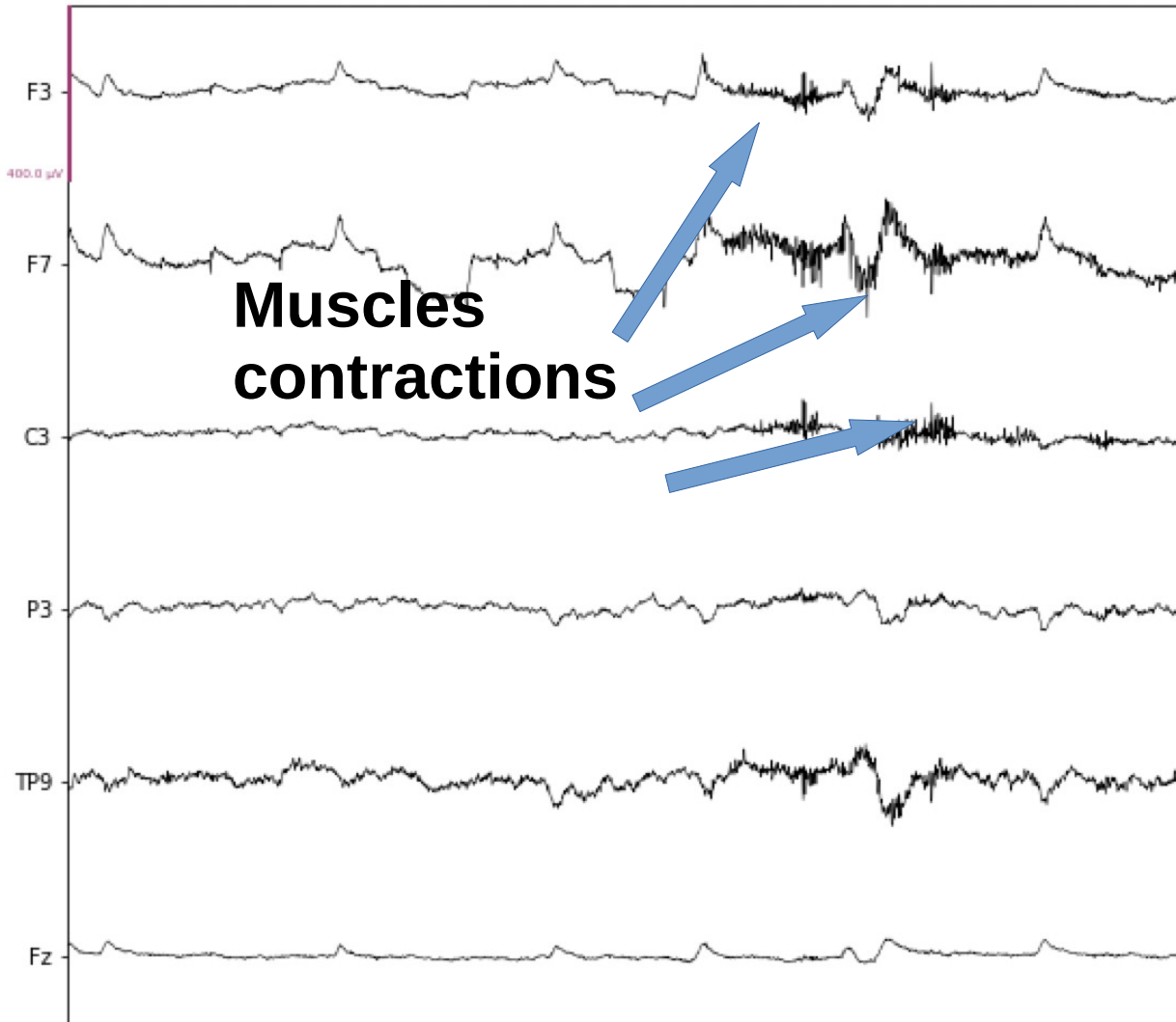
Filtering

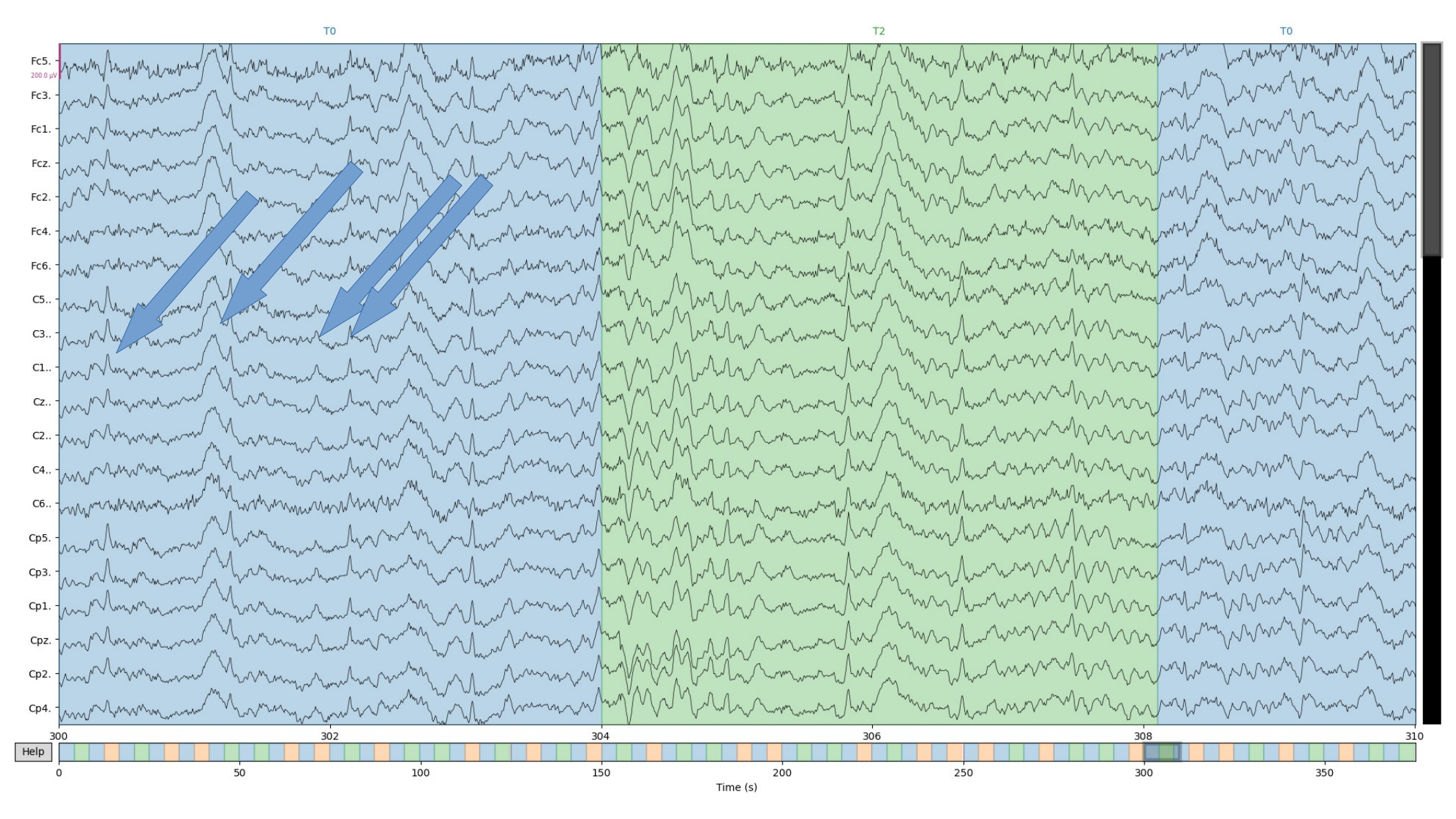
Frequency of the electricity system



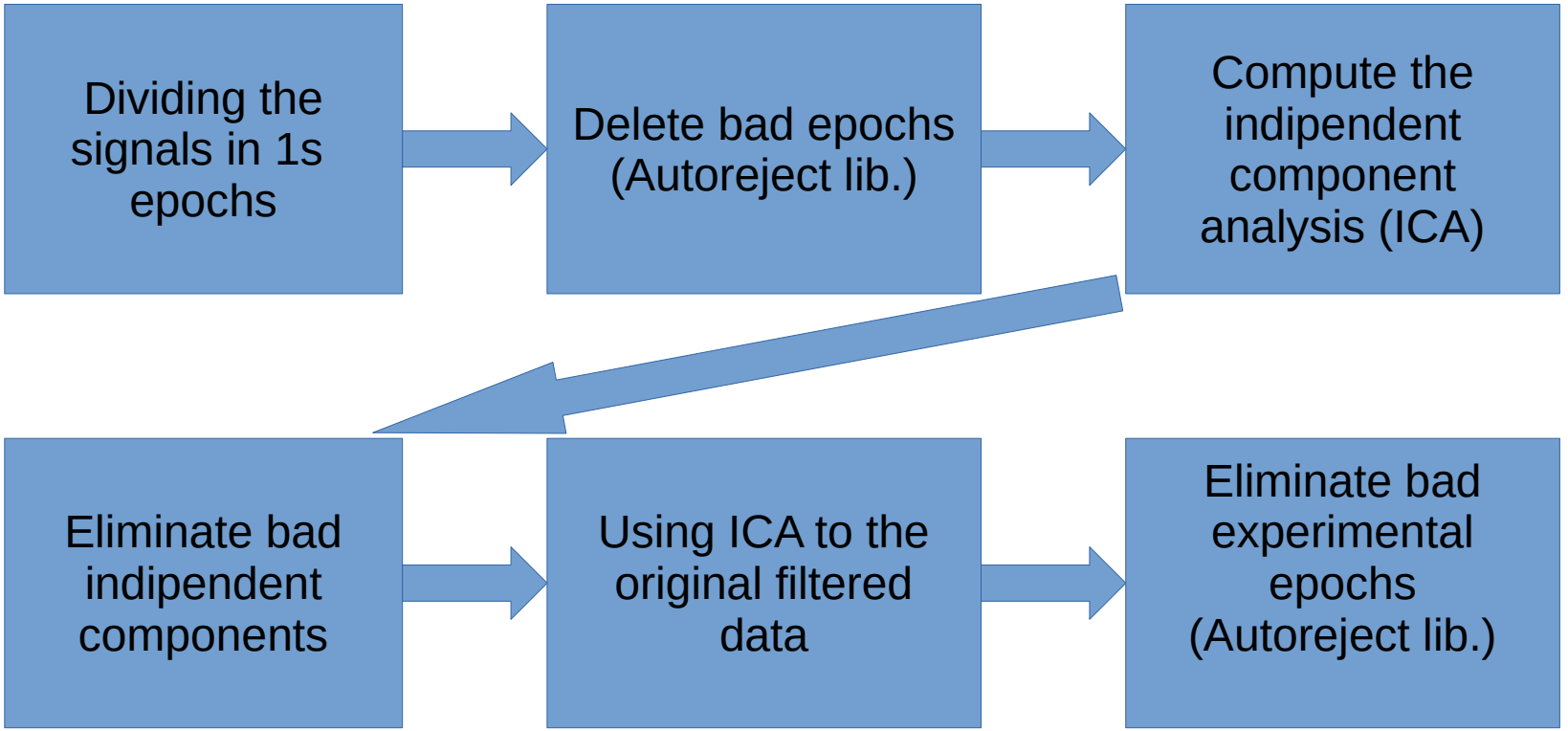
Artifacts detection



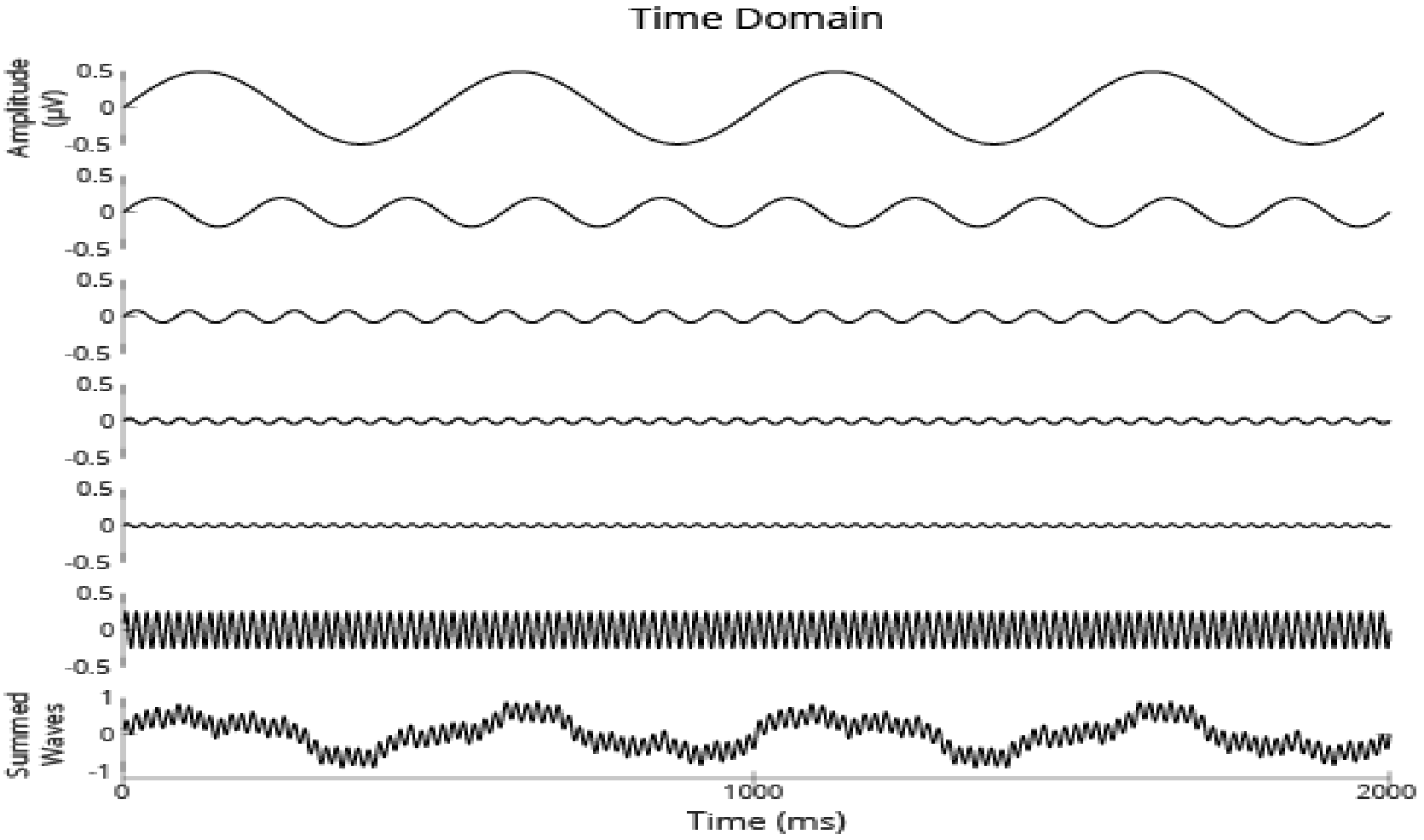


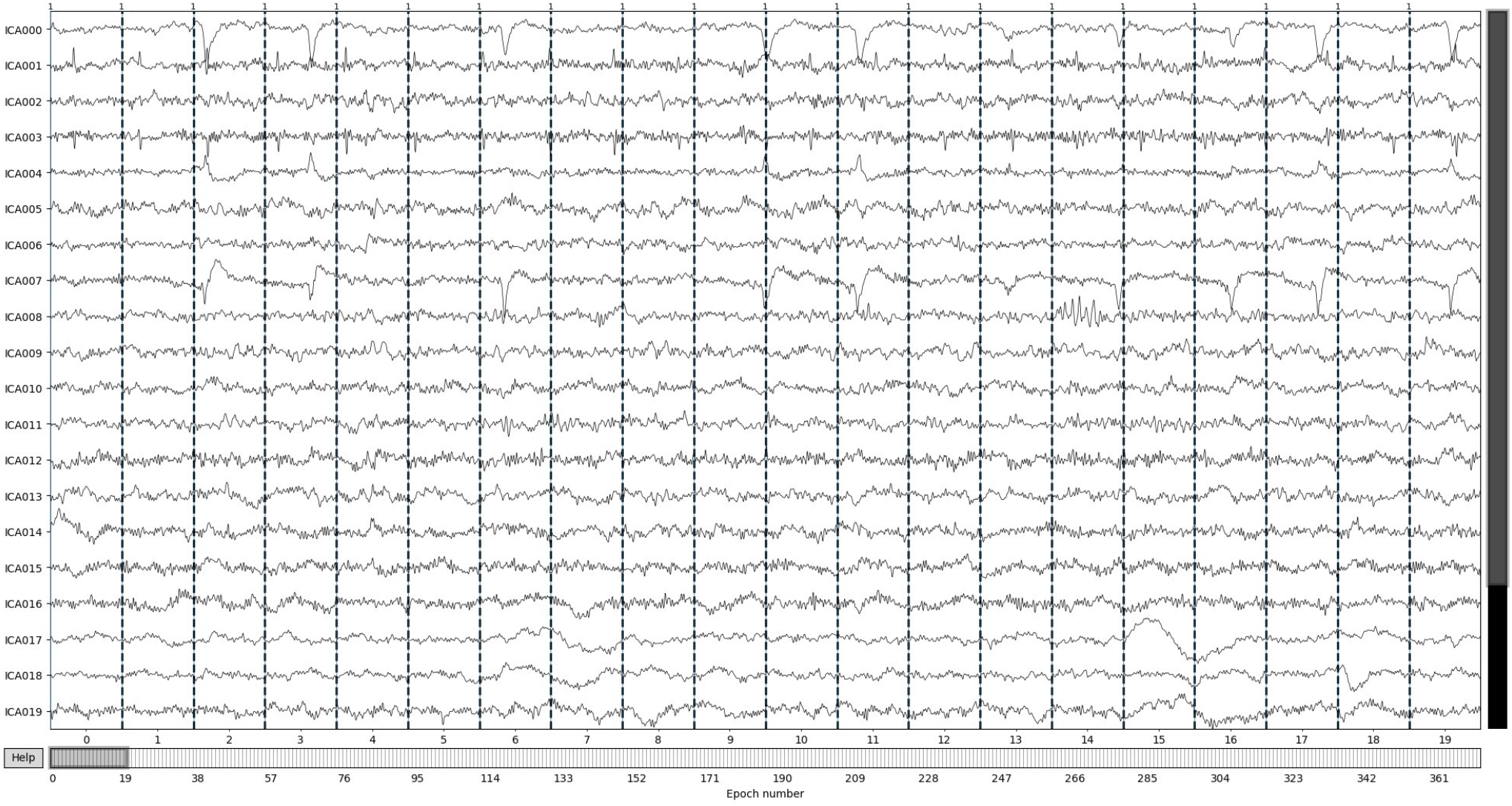

T0
T2
T0
Fc5.
200.0 µV
Fc3.
Fc1.
Fcz.
Fc2.
Fc4.
Fc6.
C5..
C3..
C1..
Cz..
C2..
C4..
C6..
Cp5.
Cp3.
Cp1.
Cpz.
Cp2.
Cp4.
300
302
304
306
308
310
Help
0
50
100
150
200
250
300
350
Time (s)

Automatic artifacts elimination



Indipendent component analysis




ICA000
ICA001
ICA002
ICA003
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ICA016
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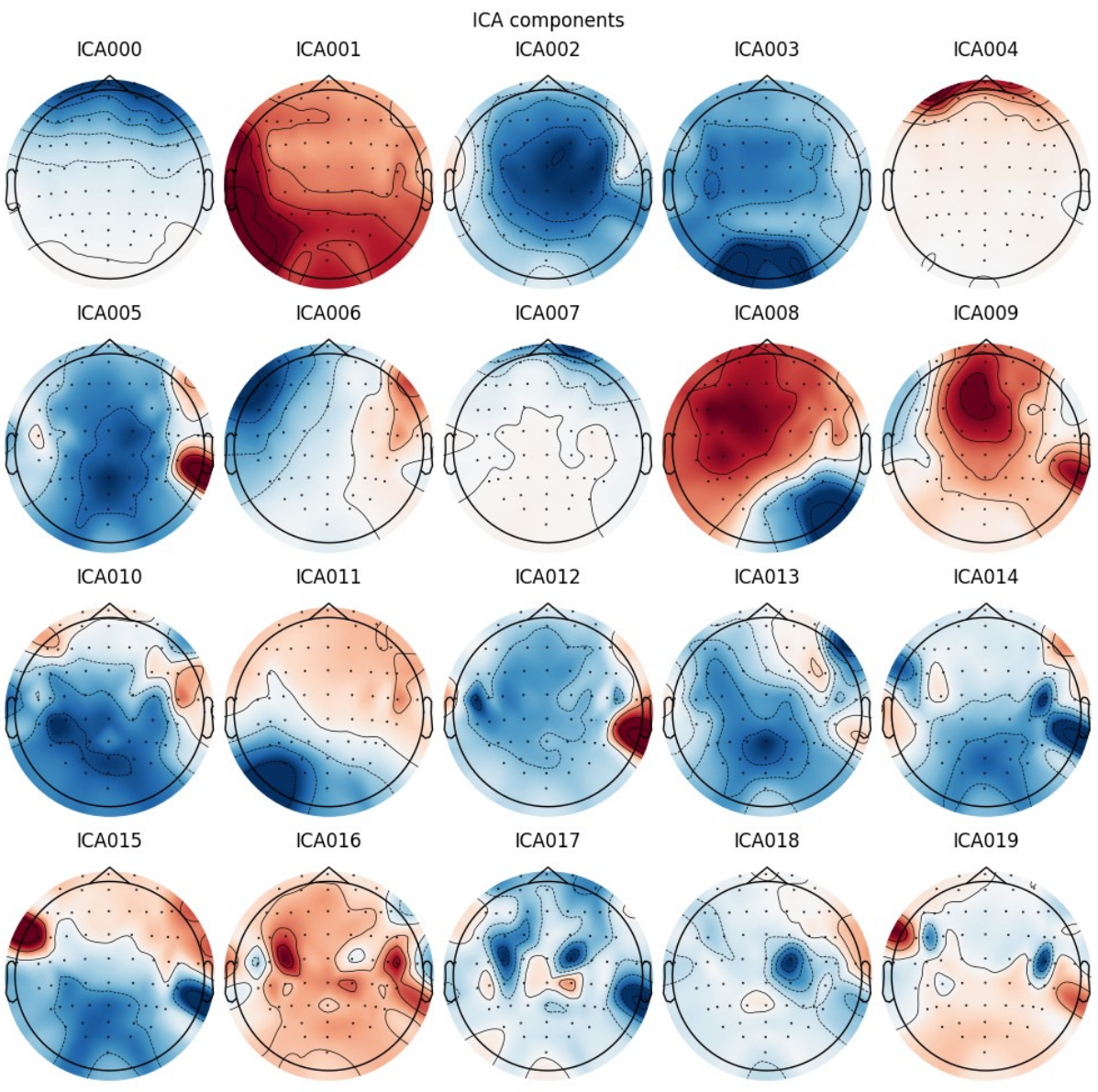
Help
0 19 38 57 76 95 114 133 152 171 190 209 228 247 266 285 304 323 342 361
Epoch number


ICA components
ICA000
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ICA017
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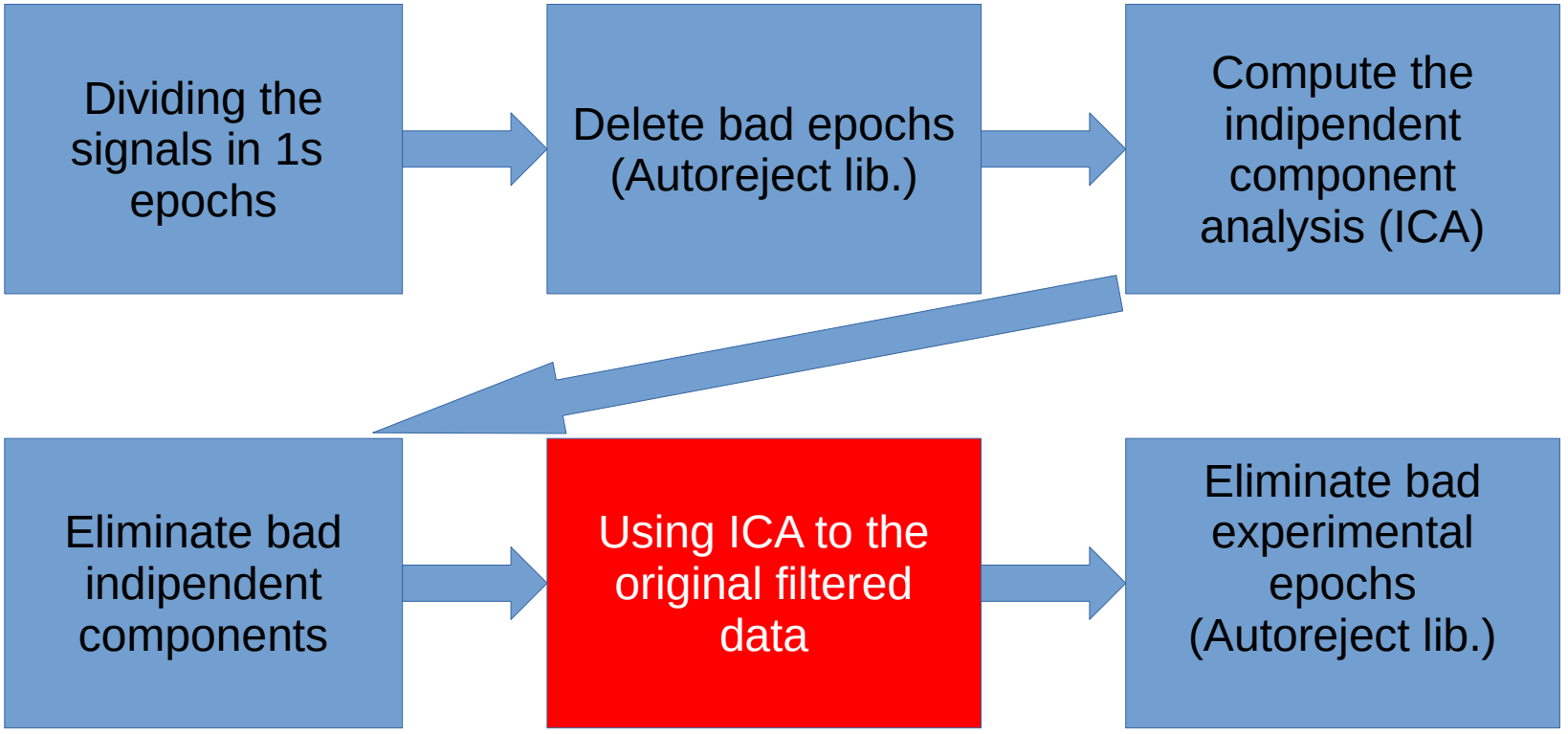
ICA019

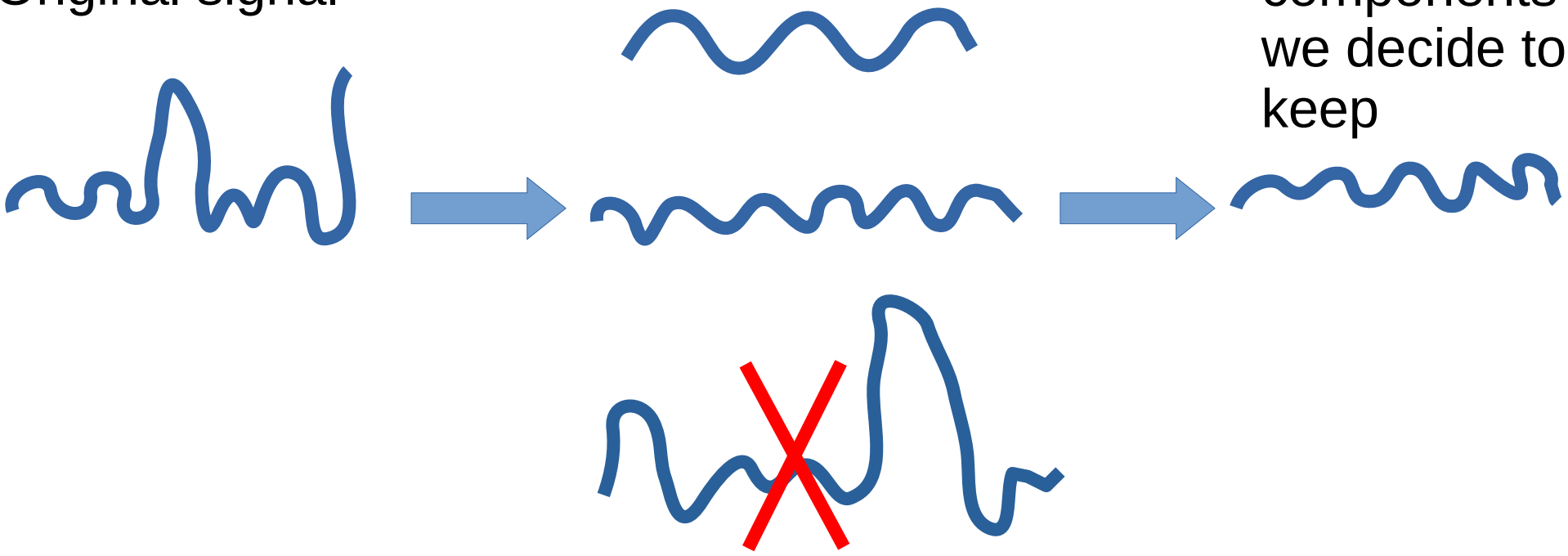
Automatic artifacts elimination



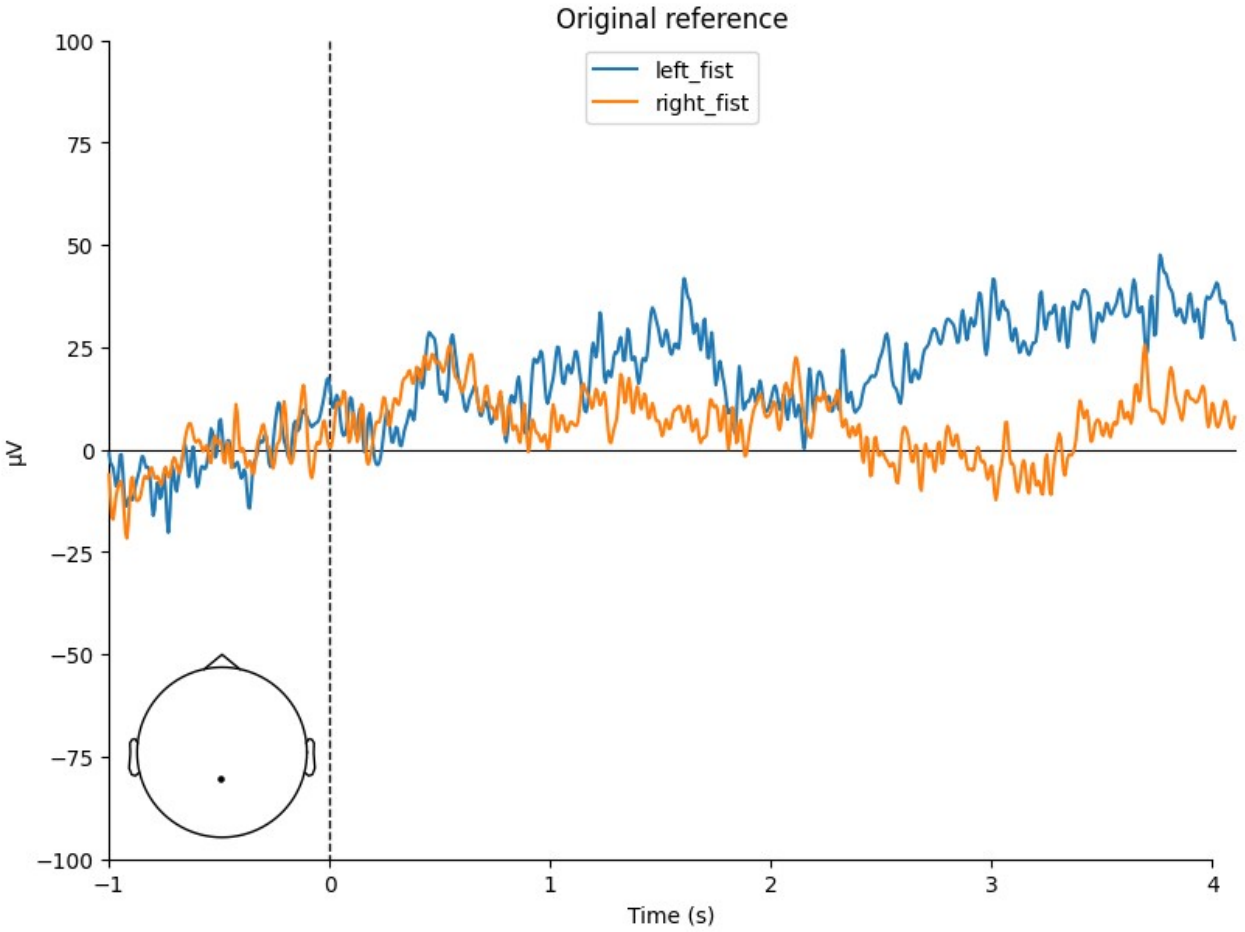
Original signal

Decomposition using the indipendent components founds with ICA algorithm

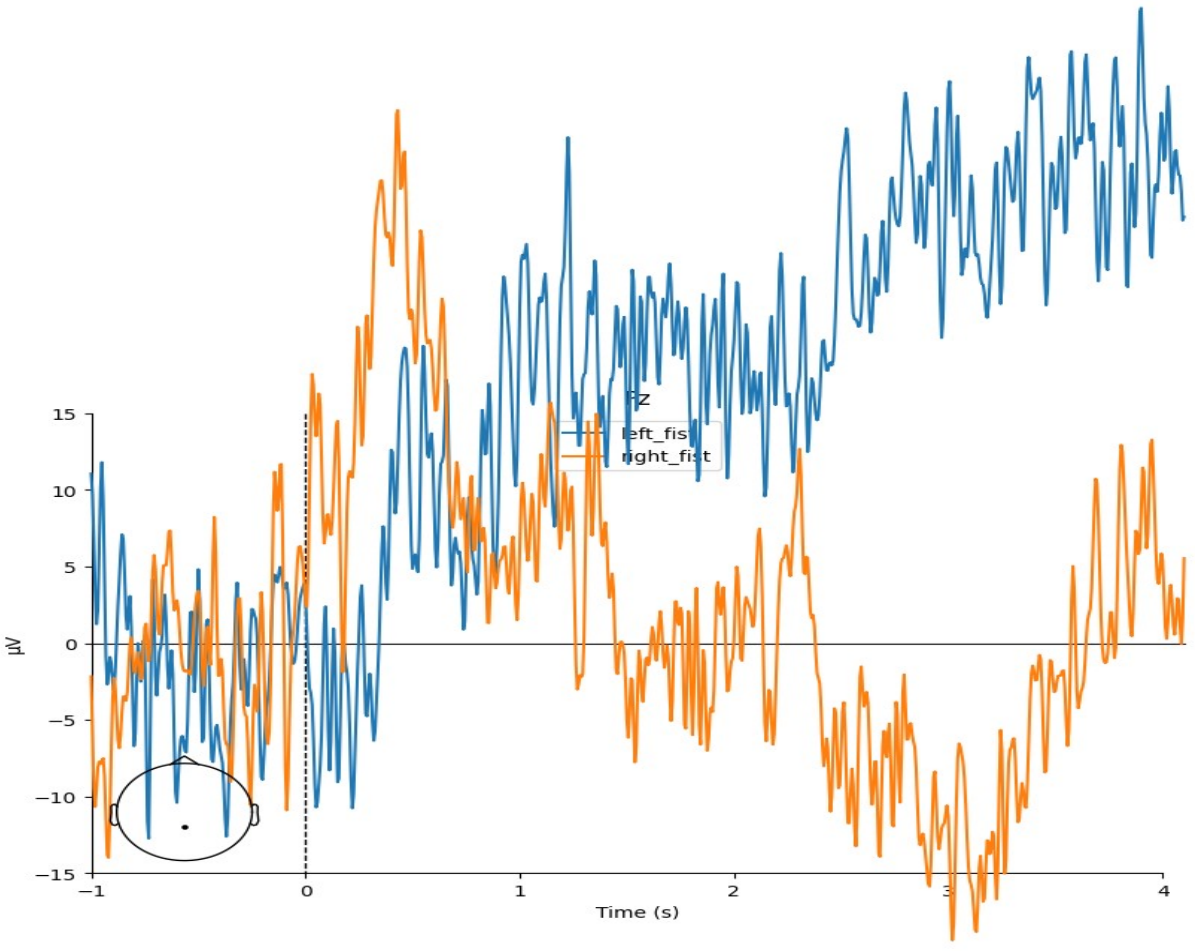
Sum back the components we decide to keep



Original Referece



Ears refactoring



Models

- Logistic Regression Model
- EEGNet (Convolutional Neural Network)

Limitations and difficulties

- Everthing was new
- Heavy preprocessing
- A lot of data

What’s next...

- Different filters
- Choose smaller sets of electrodes
- Try methods different than ICA to decompose the signals

THANK YOU!