

# Summary of Presentation

## 1. How do we measure brain activity?

- Goal: Classify between two classes (e.g. left/right arm movement, introduce with story)
- Electrical phenomena caused by neuronal activity can be measured via non-invasive EEG
- Show some examples of EEG data, introduce matrix-notation for input data
- EEG measures electromagnetic waves, might be a good idea to look at frequency

## 2. Oscillatory Analysis: Neurological background

- pyramidal cells, that are aligned in big groups and orthogonally to the scalp
- synchronous idle-oscillations,  $\alpha$ -/ $\beta$ -bands, SMR-rhythm (show frequency spectrum)
- oscillations can be measured on the EEG, as the electrical emissions add up and break through the noise-carpet
- introduce terms ERS and ERD, state significance for left/right classification

## 3. What are the challenges?

- noise from different sources, weak signals of interest
- high dimensionality with lot of redundancy, need for lot of training data
- we need another way of improving the signal-to-noise ratio and lowering dimensionality, kind of a filter

## 4. A simple approach: Laplace Filters

- Definition: Filter
- intuition behind Laplace Filters (linear combination of channels, noise cancellation over spatial average)

- Laplace filters usually not optimal (weights are determined by hand)

## 5. More sophisticated: Common Spatial Patterns

- learn optimal filters from pre-existing labelled data
- Geometry and Intuition combined with the underlying math
  - show, how covariance can be estimated from input data
  - variance maximisation for one class, minimisation for the other
  - optimisation task and it's analytical solution by solving eigenvalue problem (maybe short idea of proof)
  - interpretation of forward and backward model
- Transfer step: Relation to PCA (Compare optimisation-criteria, PCA special case of CSP)

## 6. How good is it and what can be achieved?

- brief discussion of results, that can be obtained (show some more frequency spectra)
- Downside: CSP needs hyperparameter tweaking
- maybe a little hint at other strategies, that can be utilised for preprocessing