Bachelor Thesis
@
Neural Engineering

Bachelor Thesis

Prerequisites Bachelor Thesis

- ✓ 2 dates/per year to register: SS March/ WS October
- ✓ Duration max. 6 months
- ✓ Lectures (Curriculum):
  - ✓ Modul A: Medizin und Naturwissenschaften (A1-A3)
  - ✓ Modul B: Mathematik (B1, B2)
  - ✓ Modul C (C1: Grundlagen der Elektrotechnik)
  - ✓ Modul E: Computer Science (E1-E3)
  - ✓ Modul F: Biomedical Engineering (F1, F2)
  - ✓ Modul G2: Verfassen wissenschaftlicher Arbeiten
  - ✓ Signalverarbeitung

- ✓ Register to students.bci@mlist.tugraz.at
- ✓ Science Club: Tuesday 10:15 s.t. via Webex
- ✓ One presentation at the end (10 minutes)
- ✓ Send email until 31.10.2023 night!

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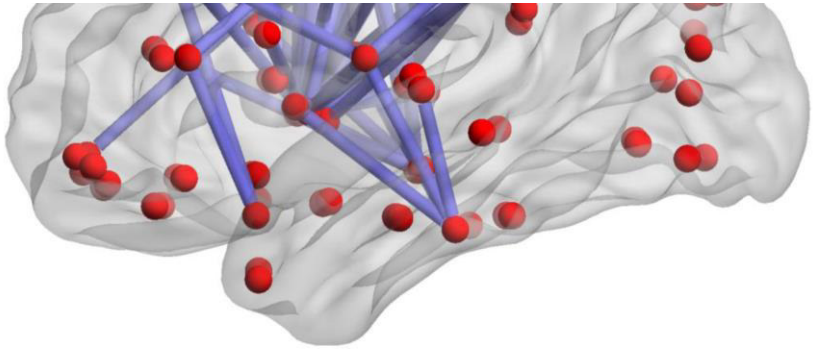
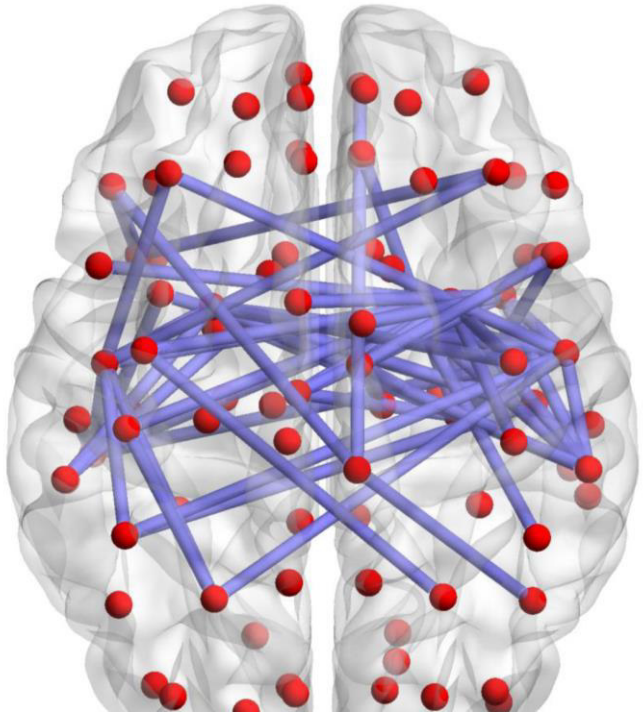
Measuring brain networks during movement



The brain is a huge network of interconnected pathways that communicate through synchronized electric activity. This thesis focuses on exploring functional connections across the brain using EEG signals during movement.



Thesis content:

- ❑ Literature review on various brain connectivity measures (e.g., coherence, mutual information, granger causality).
- ❑ Application and comparison of some of these measures on real EEG data.

Techniques: Time series analysis, time-frequency analysis, signal processing

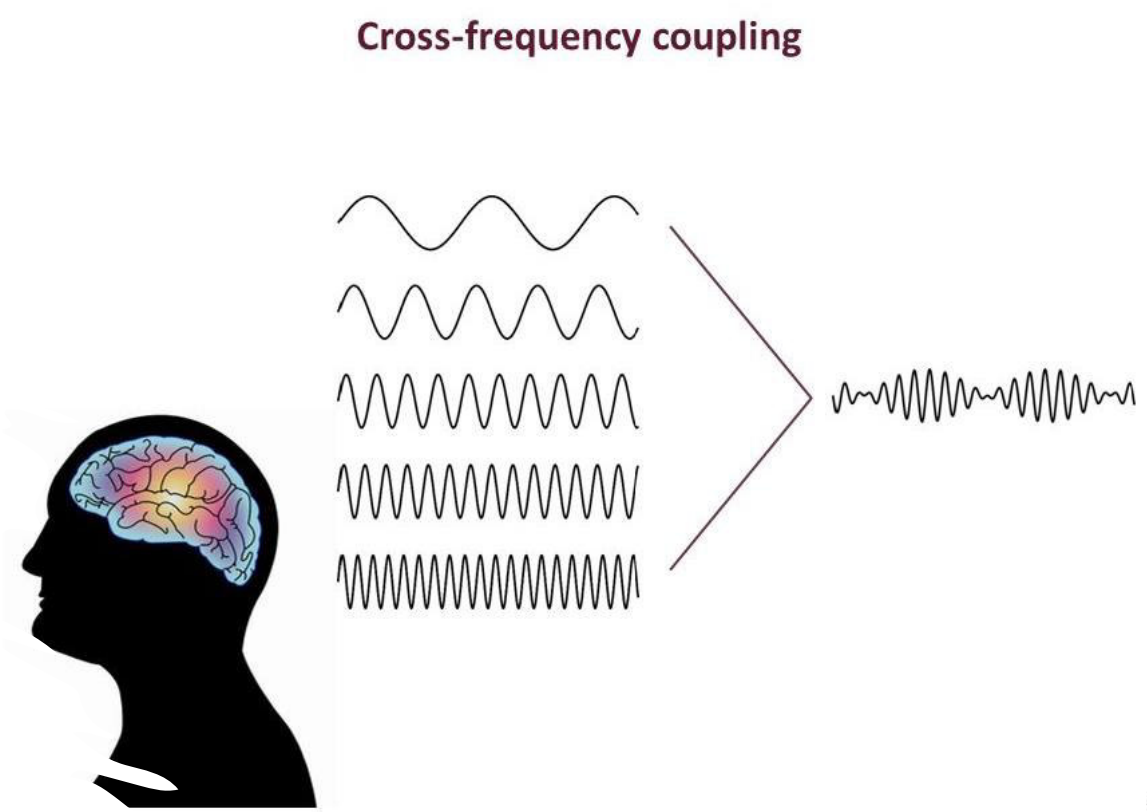
EEG-based cross-frequency couplings

Cross-frequency couplings (CFC) refer to interactions between oscillations at different frequency bands. It has been suggested that in the brain CFC serves as a mechanism that facilitates communication and information transfer between local and spatially separated neuronal populations. This thesis focuses on investigating different types of CFC using resting and task-related EEG data.

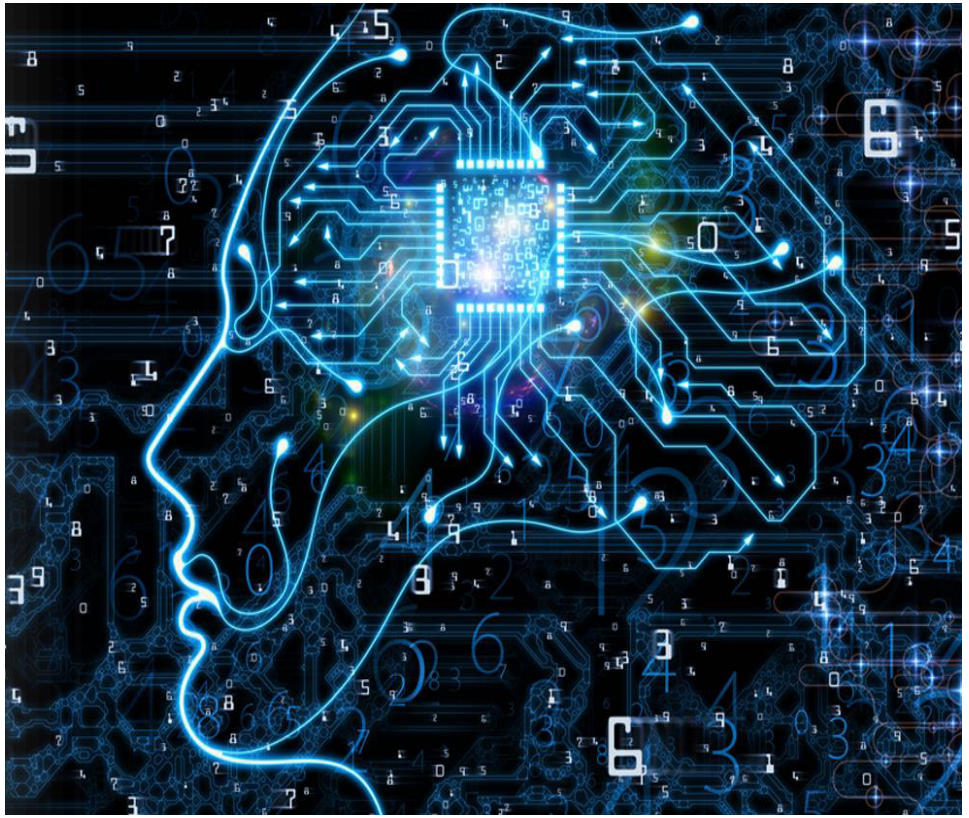
Thesis content:

- ❑ Literature review on different type of EEG CFC analysis techniques.
- ❑ Application on real EEG.

Techniques: Signal processing, time-series analysis



The effect of different pre-processing pipelines on movement attempt/execution EEG decoding



Pre-processing of the EEG signals is known to affect BCI decoding performance. The goal of this thesis is to investigate and compare various pre-processing pipelines for EEG motor attempt/execution classification.

Thesis content:

- ❑ Literature review on EEG pre-processing pipelines
- ❑ Implement and compare these pipelines based on the final classification results in motor execution/attempt data.

Techniques: Signal processing, machine learning

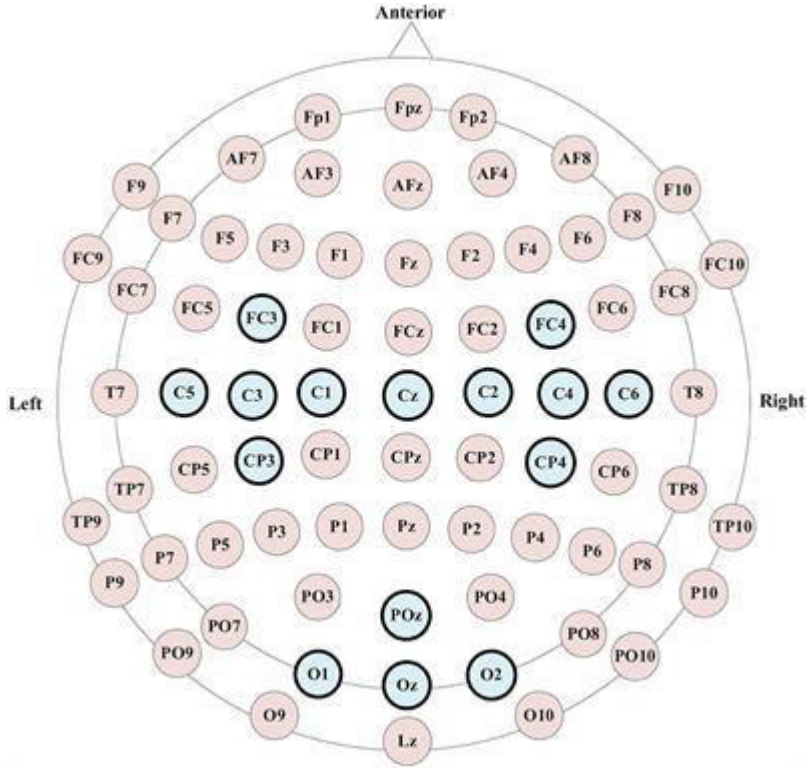
Feature selection and machine learning techniques for EEG movement decoding

Feature selection plays a crucial role in the domain of EEG movement decoding, since EEG data can be rich and complex, comprising a multitude of signals from the brain. The goal of this thesis is to investigate different feature selection strategies and test their effects on real EEG signal during movement.

Thesis content:

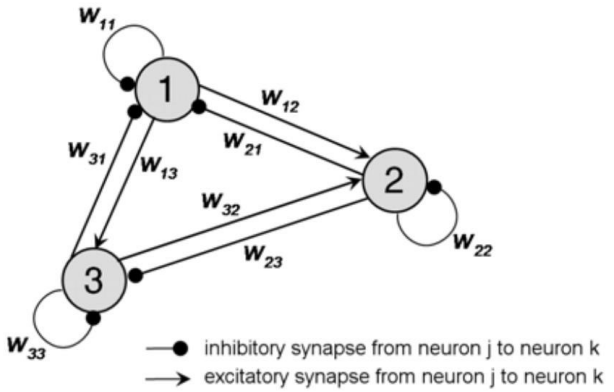
- ❑ Literature review on EEG feature selection techniques
- ❑ Implement and compare methods based on the final classification results in motor execution/attempt data.

Techniques: Signal processing, machine learning



Lenk – Topic 1:

The **LASSO (least absolute shrinkage and selection operator) method** can be used to estimate parameters for a computational model. The task is to study a given implementation of the LASSO method. The code shall be adapted in such a way that it can use spike trains provided by our model as input and estimate parameters for it. The results shall be evaluated.



Lenk – Topic 2: Adenosine receptor at the postsynapse