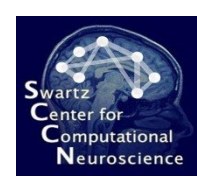




# Exercise 2: ERP Analysis in BCILAB

Introduction to Modern Brain-Computer Interface  
Design

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# About

- This is an exercise using the GUI in BCILAB
- You will be replicating the previous ERP BCI using BCILAB and then create a few variations of it using other filters, classifiers, and so on



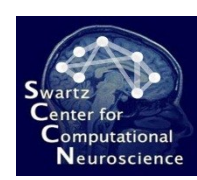
# Preparation

- Start MATLAB
- To start the toolbox GUI, type:  
`cd /your/path/to/exercise_package/bcilab-course; bcilab`



# Preparation

- **If you get *any* warnings here:** This is most likely because you have things in your MATLAB path that shadow some of BCILAB's own functions – you can temporarily reset your path to the “factory settings” for the duration of a session as follows:
  - Restart MATLAB
  - Go to File/Set Path...
  - Click Default (bottom)
  - Click Yes
  - Optionally save your settings for later



# Overview

- **Phase 1:** Reproduce the steps from the previous demo on the data that you processed in pure MATLAB in the Ex. 1 and save the results
- **Phase 2:** Design at least 3-5 BCI approaches that are variations of this analysis process using other filter or machine learning steps

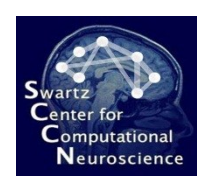
# Details

- The calibration set for this task is `/your/path/to/exercise_package/bcilab-course/userdata/errors.set`
- The test set is `errors2.set` in the same folder
- There are two groups of relevant markers in this set: the non-error events are marked with 'S 11', and the error events are either marker 'S 12' or 'S 13' (so you need a group with both markers)
  - Note the space between the S and the number
  - Do not copy these strings from the slide (the accent characters are wrong)



# Phase 1

- Train a model on the calibration set using the WindowMeans paradigm – don't forget to customize the bandpass filter, the time ranges, and the marker groups
- Save the cross-validation results (they are also in the workspace variable laststats)
- Load the test set (perhaps under another workspace name to avoid later confusion) and apply the model to it; save results
- Visualize the model weights and save the figures
- Check if it works online



# Phase 1

- **Tip 1:** If you are getting MATLAB errors: check whether you are using the correct characters in the places where you customized things; if that does not help, check if your MATLAB path is indeed clean



# Phase 2

- This is the creative part – the task now is to create at least 3-5 variations of the basic BCI design using
  - Additional or different filters (please try to come up with a rationale for your choice)
  - Different classifiers instead of LDA, or different variants of those classifiers
  - No paradigms other than WindowMeans
  - Run through the usual analysis steps – cross-validation, application to test set, visualization if applicable (note: only a subset of methods have a reasonable visualization), quick online check



## Phase 2: For Pros

- Try to identify the three best methods in terms of test-set performance (the default is pretty good – it is okay if your approaches are slightly worse)

# Phase 2: Tips

- **Tip 1:** To make good choices, please browse the documentation in the GUI and in the Help menu to see what's available
- **Tip 2:** Stay away from the slow methods for now (not enough time to run through them); in particular:
  - Any classifier that has a search(...) term as one of the default parameter values (e.g. Kernel SVMs), although you might replace this by an ad hoc value
  - ICA, Dipole Fitting, Sparse Reconstruction, Volume Selection, HKL
- **Tip 3:** Some methods work only if certain preconditions are met in the data – don't be discouraged if you are getting MATLAB errors!