Documentation

1. run_session_liveEEG.py

This script is used for realtime processing of motor imagery for three classes (left, right, both). It is a modification of run_session.py to allow live processing and classification of EEG data. The process of classification is divided into three steps:

- Phase 1: collect data
- Phase 2: analyse and classify collected data and build model
- Phase 3: uses model to classify every trial live

To start the experimental paradigm, start the command window in the folder of the script and enter the following (t: number of trials, f: sampling frequency, a: participants' age, g: gender, l: number of notlive trials). Make sure, that the folders 'images' and 'sounds' are saved a level higher in the path.

```
>python run_session_liveEEG.py -t 72 -f 256 -a 25 -g male -l 66
```

Explanation of the most important functions in the class MyApp_liveEEG():

- run_session(): calls the function run_trial() as often as defined in the command window (number of trials)
- run_trial(): In this function the three steps of classification are implemented.
  It starts with state 1, the recording of data nonlive. When all notlive trials are performed, the classification of notlive data starts (state 2). It calls function classify_notlive(). After that, the live trials and the live classification start (state 3). Therefore it calls the method classify_live() in the class live_EEG() in eeg_motor_imagery_NST_live.py
- show_motor_imagery(): contains the actual procedure of each trial which is explained in the experimental paradigm, e.g. displays arrows and plays beep
- classify_notlive(): is used for classification of the recorded data; saves recorded data and calls class liveEEG() and function fit() in eeg_motor_imagery_NST_live.py for building a model with the saved data

2. record_data_liveEEG.py

This script is a modification of record_data.py to allow the usage of run_session_liveEEG.py. It is mainly used for recording and saving the data. In comparison to record_data.py, there are the new functions stop_recording_and_dump_live() and get_last_trial(). The first one is necessary to save the data of the live trials in a new file. The function get_last_trial() is important for live classification. It extracts the data of the last trial and saves it to an instance of the class NST_EEG_LIVE, which is handed back, so this trial can be classified live during the recording session.

3. eeg_motor_imagery_NST_live.py

In this script, the class liveEEG() is defined. Functions of this class are __init__(), fit() and classify_live(). It is based on the jupyter notebook example for EEG motor imagery classification (www.gumpy.org).

- __init__(): loading of the recorded notlive data, preprocessing of the data, e.g. filtering and feature extraction
- fit(): builds a model with data from all notlive trials. Uses the sequential feature selector, which is implemented in gumpy and uses the chosen features to build the model.
- classify_live(): classifies every trial live. First, there is the same preprocessing of the live data as in __init__(). Then the prediction of the live trial is performed, and it is checked, whether the prediction is true.

There is also a file eeg_motor_imagery_NST_live_split.py which is only necessary for using the test script with splitting of the data.

4. nst_eeg_live.py

This script has to be saved in the directory gumpy > data. It is an adaption of nst.py, which is necessary for live processing. Mainly, its function is to load the data each for the notlive trials (load()) and the live trials (load_from_mat()).

5. TEST_live_EEG-Run12_Run3.py and TEST_live_EEG-Split.py

These scripts are used to test the functions in eeg_motor_imagery_NST_live.py and nst_eeg_live without having to call them from run_session_liveEEG.py or record_data_liveEEG.py. They work for 2 and 3 classes, this parameter can be changed in nst_eeg_live.py, nst_eeg_test.py and nst_eeg_test_split.py.

In TEST_live_EEG-Run12_Run3.py the training of the model is done with two Run.mat files and the testing with another Run.mat file.

In TEST_live_EEG-Split.py the data of all runs is concatenated and then splitted into training and testing data with a modifiable ratio. For using this test script, you have to use eeg_motor_imagery_NST_live_split.py.

6. nst_eeg_test.py and nst_eeg_test_split.py

These scripts are an adaption of nst_eeg_live.py and are only used for testing purposes. They have to be saved in the directory gumpy > data.