

Meyendtris Tutorial Using LiveAmp

Introduction:

Meyendtris is a technically challenging BCI demonstration that requires the use of several different opensource toolboxes including the Matlab BCI toolbox from SCCN, BCILAB. Below is a step by step manual describing how to set up and run the demonstration.

As is the case with most BCIs, there is both a calibration phase and an online phase. During the calibration phase, a subject will go through an EEG paradigm to record calibration data. Once completed and if done using the correct configuration, a simple Matlab script called 'onlineMeyendtris.m' can be called from within BCILAB. This will classify EEG data, output a value based on the analysis, and will automatically connect to the Meyendtris game itself.

The backend for both the calibration paradigm and the Meyendtris game is **SNAP**. The control over this presentation engine is kept as high level as possible, sparing the researcher the details of SNAP programming and setup. However, there may be the need to make a few fine tuned adjustments to the global display settings. This is not a SNAP programming tutorial, but hopefully it provides all the necessary documentation for using this software without problems.

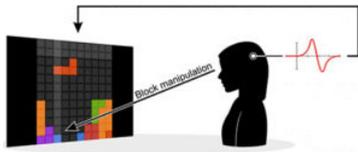
The BCI component of Meyendtris is a passive one. It is a simple mental workload classifier that relies on alpha activity as a feature. The output of the classifier controls the speed of the Tetris game. The actual control of the tetrominos on the game field is done with classic keyboard commands, or (optionally) with an eyetracking device. Instructions for setting up such a device are also included.

Dependencies:

- (1) **Meyendtris**
- (2) **BCILAB**
- (3) **LabRecorder**
- (4) **LiveAmp LSL Connector**
- (5) Matlab (tested on 2015b)
- (6) (Optional) LSL or mouse enabled eyetracker

Installation instructions:

- (1) Meyendtris:
 - Simply unzip the **package** and put the containing folder somewhere convenient.
- (2) BCILab:
 - If you have git installed:
 - open a command prompt, navigate to a convenient directory and type at the prompt:
 - `git clone https://github.com/sccn/BCILAB.git`
 - then, switch to the devel branch of BCILAB by first switching into the BCILAB directory, then checking out the devel branch:
 - `cd BCILAB`
 - `git checkout devel`



- If you don't have git installed:
 - visit the [BCILAB repository on github](#)
 - switch to the devel branch using the pull down menu called 'Branch:' and select devel
 - after the new page loads, click on the green 'Clone or download button' and select 'Download ZIP'
 - after downloading the archive, unzip it and put the folder in a convenient directory

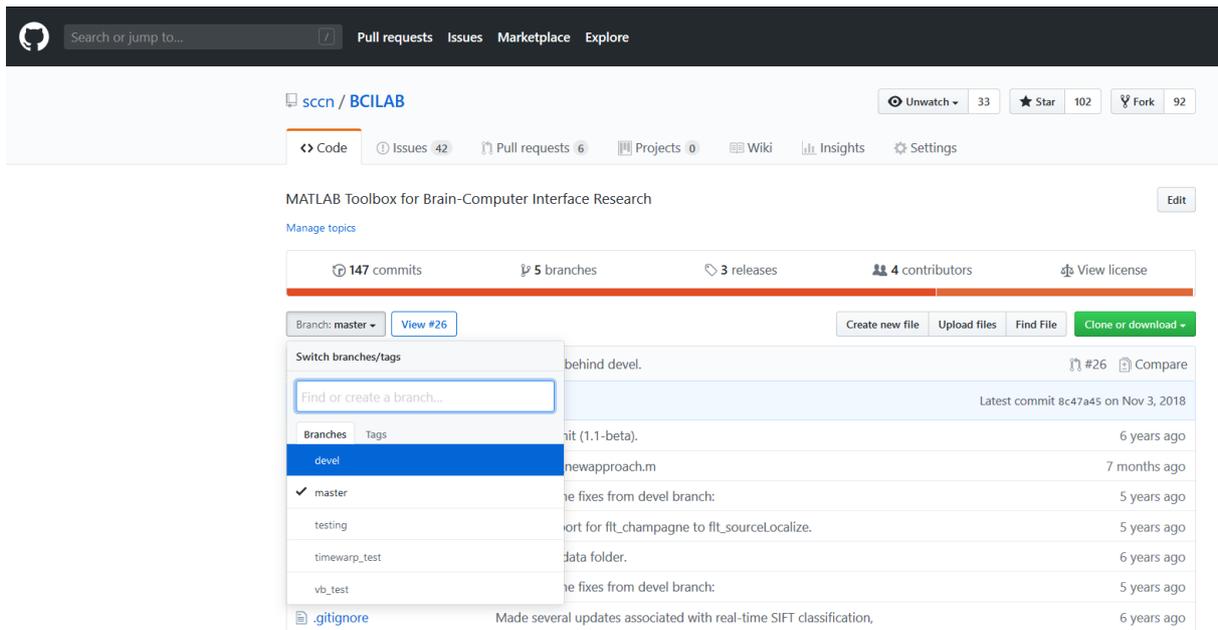
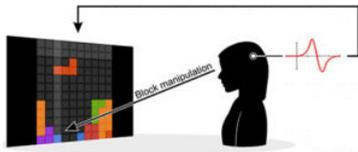


Figure 1: The BCILAB repository on github.

- Once you have the BCILAB devel branch copied to your PC, start Matlab. If you have any reference to EEGLab or libls-Matlab on your Matlab Path already, you must remove these before loading EEGLab. In fact it is recommended to completely clear your Matlab Path before running BCILAB.
- Within Matlab navigate to the folder called BCILAB that you have just unzipped or cloned and type bciLab at the Matlab prompt. This will load BCILAB, its dependencies, add directories to your Matlab Path, and change directory into <path>BCILAB\userscripts. If you receive no errors, BCILAB is up and running in Matlab.
- NOTE:
 - BCILAB relies on a number of Matlab toolboxes that you might not have. This can cause performance issues during calibration (slow loading).
 - BCILAB will create a cache folder called 'BCILAB-temp' in the directory that holds the BCILAB folder. You may have to delete this between runs. You may also have to delete the configuration folder in your home directory called '.bciLab'. This is an invisible folder (preceded by a '.') so you may have to configure Windows so that it will show you invisible folders. If you have problems re-loading BCILAB after an initial run, exit Matlab, delete these two directories and reload BCILAB as in the previous step.
 - When loading BCILAB, BCILAB will automatically configure your Matlab Path and change the directory to BCILAB\userscripts. It is important to keep Matlab in this directory and not to make any manual adjustments to the Path after loading BCILAB.



(3) LabRecorder:

- Simply download the appropriate version from [github](#) and place the unzipped folder in a convenient directory. Double-click on LabRecorder.exe to start the LabRecorder.

(4) LiveAmp LSL Connector:

- Simply download the appropriate version from [github](#) and place the unzipped folder in a convenient directory. Double-click on LiveAmp.exe to start the LiveAmp LSL Connector.

Running Meyendtris:

Prepare the EEG:

- The first step is usual EEG preparation, appropriate to whichever electrodes are being used. Apply the EEG electrodes to the subject in the normal way and check impedances using Brain Vision Recorder. Once Impedances are in a good range, switch to monitoring mode and make sure that the EEG looks good and that Alpha waves are visible when the subject closes her eyes. Once the EEG is satisfactory, close Recorder.

Prepare for Calibration:

- Navigate to the directory with the Meyendtris demo in it.
- Change into <path>\Meyendtris\demo and double click on 'launcher-Meyendtris.bat'. This will launch a command-line tool for controlling Meyendtris.

```
C:\WINDOWS\system32\cmd.exe
TeamPhyPA :)
Physiological Parameters for Adaptation : / teamphypa.org

Meyendtris
1 Calibration (Alpha)
2 Classifier Test (Bar)
3 Meyendtris

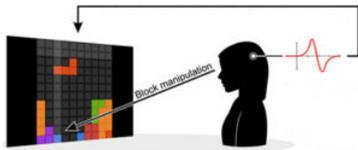
- options
> -

host: DM-LAPTOP
cwd: C:\Users\David.Medine\meyendtris_latest\demo\src
lsl_api.cfg not found in user directory

s toggle LSL SessionID
> 1
```

Figure 2: Meyendtris launch program.

- Start LabRecorder.exe



Run Calibration Paradigm:

- First, connect to the LiveAmp using the LiveAmp LSL Connector:
 - Run the application
 - Click 'Scan' to search for devices (this will take a few moments)
 - The serial number for your device should automatically appear in the Device Number field and the number of channels should automatically reflect what kind of LiveAmp it is (8, 16, 32, or 64 channel).
 - Uncheck 'Enable ACC sensors' and all the trigger output options.
 - Click 'Link'
 - Once linked, you should be able to see the stream in LabRecorder by clicking the 'Update' button.

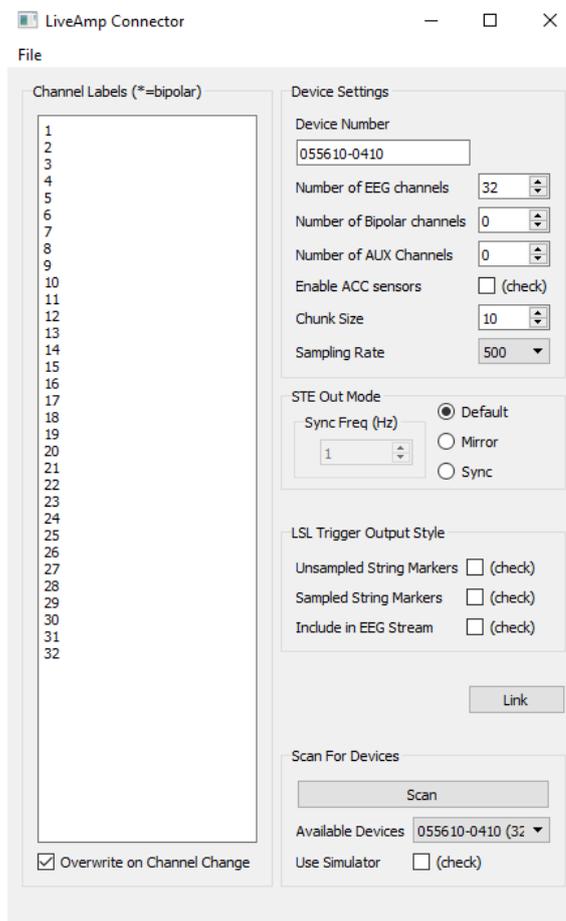
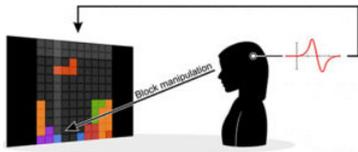


Figure 3: The correct configuration for using 32 channel LiveAmp in Meyendtris.

- The batch file 'launcher-Meyendtris.bat' gives 3 options. The first is Calibration. Enter '1' at the prompt in order to launch the calibration paradigm. When you do this, the main monitor will go full screen in presentation mode and instruct you to 'Press space to continue'. Before proceeding, you will have to configure LabRecorder and begin the recording. You can alt-tab to focus on LabRecorder and go back to the paradigm later.



- Configuring LabRecorder:
 - First click 'Update'. There should be two streams available, the LiveAmp stream and the SNAP-Markers stream. When these streams appear, check the boxes so that LabRecorder will record them. There is also a 'Select All' button.
 - Uncheck the 'BIDS' option on the right hand side of the GUI.
 - For Study Root, click 'Browse' and navigate to the directory 'C:\MeyendtrisData'. If it doesn't exist, first create it.
 - NOTE: This is the default storage directory for Meyendtris. You can choose any directory, but this change needs to be reflected in line 9 of the file <path>\Meyendtris\scripts\onlineMeyendtris.m
 - For the 'FileName/Template' field enter 'Meyendtris-%p-calibration.xdf'
 - %p will be rendered as the number given in the Participant field when the recording begins. Usually, people start with '1' and count up ;-). The rest of the fields don't apply in this case and can be anything or just empty.

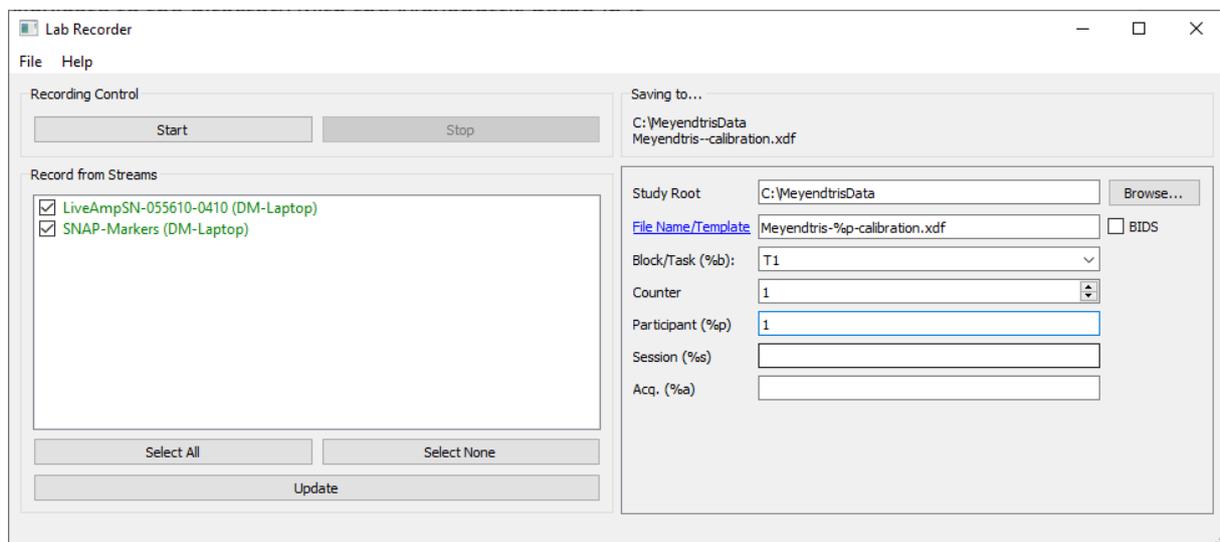
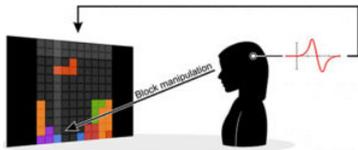


Figure 4: LabRecorder correctly configured to record Meyendtris calibration data.

- Once LabRecorder is correctly configured, click 'Start'. This will begin the recording.
- Now it is time to go back and focus on the SNAP presentation which will present the calibration paradigm. There are two conditions. One is simply a fixation cross. The other is rapidly flashing rectangles of different colors. The subject should be instructed to relax during the fixation cross, and to try to count the number of yellow rectangles during the other condition. The subject should be instructed to focus on the screen and press the space bar to proceed. Once the paradigm has finished, stop the recording in LabRecorder. (NOTE: you can save your configuration in LabRecorder for ease of use in future sessions by clicking on 'File->Save Configuration'.)

Prepare for the online BCI:

- Now Focus on Matlab.
- In Matlab (after having carefully loaded BCILAB) add the directory containing the Meyendtris scripts to the Path. I put Meyendtris in my home directory so on my PC this path is C:\Users\David.Medine\Meyendtris\scripts. You will need this saved in your Matlab Path in order to call the script 'onlineMeyendtris.m' later on. Remember to keep Matlab in the 'userscripts' folder after loading BCILAB. It won't work otherwise.



- Presuming that BCILAB was correctly installed, loaded, and the directory containing 'onlineMeyendtris.m' is saved to Matlab's Path, it is time to calibrate and run the online BCI.
- To do this, simply issue the command 'onlineMeyendtris(n)' at the Matlab prompt where 'n' corresponds to the number of the participant that was just recorded in the previous step. This may take some time, but BCILAB will report the estimated accuracy of the classifier when it is finished.

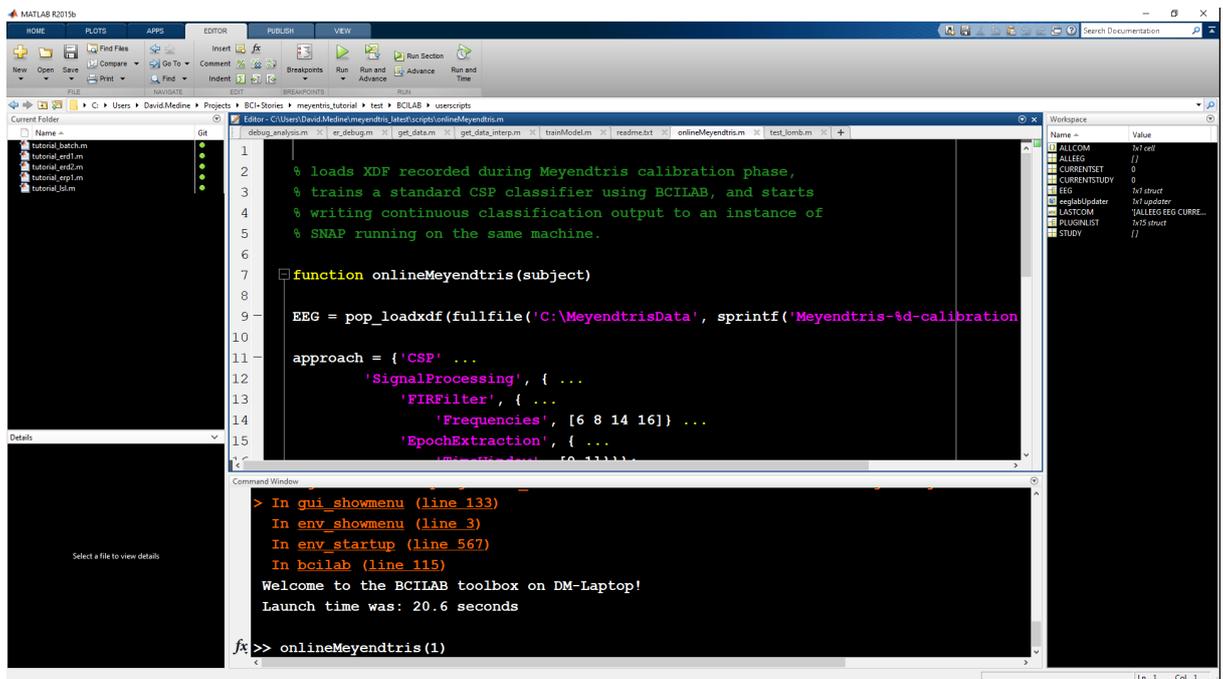
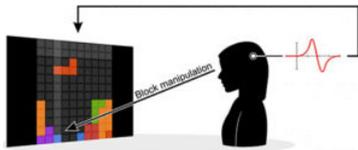


Figure 5: Preparing to run Meyendtris online.

- Once the BCI is calibrated, BCILAB will look for an EEG device stream in LSL. If the LiveAmp stream is still running, it will connect immediately. It will then look for an instance of SNAP to connect with. It will wait for this to occur.

Check the BCI performance using the Classifier Test (optional)

- This step is only necessary if you want to check the accuracy of the classifier before starting the Meyendtris game.
- Focus again on the Meyendtris launcher console and select option 2.
- When run, a bar meter will appear on the center of the screen. When the subject is stressed, the classifier should push the meter high, when relaxed the meter should be low.
- NOTE: This program does not exit elegantly. In order to quit, you will have to force quite the process ppython.exe from task manager. To do this:
 - Prese **ctrl+alt+delete**
 - Choose **task manager**
 - Select the **'Details'** tab which displays all running process in alphabetical order
 - Highlight **'ppython.exe'** and click the **'End Task'** button.



Setup an eyetracker for hands-free mode (optional)

- Option 1, mouse substitute:
 - Many eyetrackers can be configured to control the mouse cursor.
 - In this case, calibrate and configure the eyetracker to do so.
 - Then, run the app `Mouse.exe` which is provided in the directory `<path>\Meyendtris\misc\Mouse`.
 - Click 'Link'. This app will now forward your mouse cursor coordinates to Meyendtris via LSL.
- Option 2, use LSL enabled eyetracking:
 - Also provided in `<path>Meyendtris\misc` is a Python app which will forward eye-gaze information from a Tobii-x230 screen mounted eyetracker.
 - Follow the instructions provided in the file `<path>\Meyendtris\misc\Tobii230\README.txt` to set this up
- Option 3, use any LSL enabled eyetracking system:
 - Any eyetracker that can output x,y gaze information as an LSL stream can be used.
 - It is important that the values be formatted as floating point values in the order `[x,y]` with `[0,0]` being the upper left-hand corner and `[max_x, max_y]` being the lower right-hand corner (where `max_x` and `max_y` correspond to the screen resolution of the monitor).

Run Meyendtris:

- Once the eyetracker is configured and connected to LSL (or not, if you just want to use the classic keyboard controls) the online Meyendtris game is ready to run.
- Focus again on the Meyendtris launcher terminal and choose option 3.
- Once the game loads, BCILAB (which is presumably still running) will find the SNAP marker stream and connect automatically to the game.
- Press enter to start Meyendtris.
- The pieces will move according to the position of the eyegaze (shown by a dot on the board). Attend your gaze to the upper light-grey squares to rotate the piece. If you stare at the piece for a few seconds it will drop. If your mental workload increases, so will the speed of the game so it's important to stay relaxed!

NOTE: some of the demo's behavior, notably the screen resolution, is adjustable by altering the settings in the files `<path>\Meyendtris\demo\src\studies\calibrationdisplaysettings.prc` and `<path>\Meyendtris\demo\src\studies\meyendtrisdisplaysettings.prc`. It is important the screen resolution stated in these files correspond to the actual screen resolution of your main monitor. Otherwise, it might look a bit funny.