BCI User Guide

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1 Introduction

In this user guide you can find all the information of how to set up and use the BCI system. At the end of the document you find some of the most common errors you can encounter and how you can solve them.

If anything remains unclear after reading the user guide you can contact the designers of the system by filing a new issue to `https://github.com/VeerleTwee/BCI/issues`.

2 Setup

2.1 Download Scripts

To work with the BCI you need to download a master BCI package and the BCI scripts.

1. Download the buffer BCI Master from GitHub

   - Go to `https://github.com/jadref/buffer_bci`
   - Click on "Clone or download" and select Download ZIP
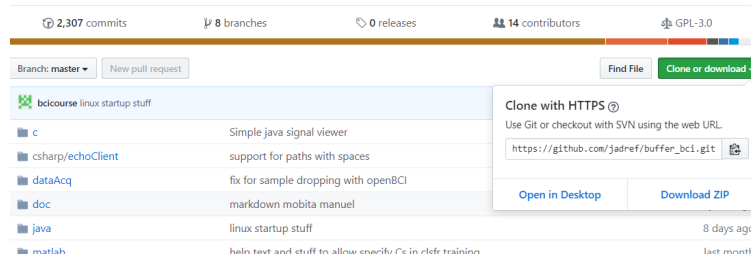
   - Save and unpack the zip file on your computer.

2. Download the BCI script from Github

   - Go to `https://github.com/VeerleTwee/BCI.git`
   - Again, click on "Clone or download" and select Download ZIP.

 - Save and unpack the file in the $buffer_b ci$.

2.2 Matlab Setup

The next steps will assume you have a recent version of Matlab already installed and running on your computer.

1. Go to `http://psychtoolbox.org/download` and follow the instructions.

2.3 EEG system

To be able to record brain signals from the subject we use a portable 32-channel EEG system.

2.3.1 Starting up the system

1. Push the on-button to start the EEG device.

2. Insert the USB dongle into your computer.

3. Go to the *buffer_bci-master* folder on your computer.

4. Open the folder *dataAcq*.

5. Run *startJavaBuffer.bat*.

6. Run *startMobita_autoconnect.bat*.

   - Check the code on the back of the EEG device.
   - Find the corresponding echo code in the Mobita window and type it in the window.

7. Run *startSigViewer.bat*.

   - Select the 32 channel system.

2.3.2 Fitting the cap

1. Choose a cap such that it is tightly connected to the head of the subject.

2. Use a syringe to wet the head skin under the wholes in the cap and move hair asside as good as possible.

3. Get 32 sponges and put them in water together with the wristband.

4. Untangle the EEG electrodes, insert the sponges, and place them on the cap as shown in the signal viewer.

5. Put the wristband on the subjects arm until it is tight.

6. Instruct the participant to sit still and do nothing to check for bad connections.

   - Wait until the signal viewers shows signals in the 20 Hz range.
   - Check for signals that are extremely big or otherwise differ from the other electrodes.
   - get the electrode out, wet the sponge and the head again, remove hair and place the electrode back.
   - repeat this step until all channels are ok.

3 Usage

3.1 Calibration

The calibration is the first step to make the brain computer interface functional for the person that will use it in the end. To start the calibration follow the next steps:

3.1.1 Creation of the classifier

The classifier is the most important component of our system, since it is the one that will be trained in order to predict the decision we are taking in the BCI.

1. Start up Matlab.

2. In Matlab, navigate to the folder *BCI*.

3. Open *CalibrationSsvepSigProFinal.m* by double clicking it.

4. Run the script.

5. The program will ask you for input

   - 'Enter the name of the subject?' : type the name of the subject.
   - 'Enter the technique you want to use, choose between: freq or time : ' Here type either the word 'freq' either the word 'time' (both of the words without the quotation marks) and press enter. If you do not know what to choose just press enter.
   - 'Enter the classification technique you want to use, choose between: MLR or ERSP : ' Again here choose one of the two methods by typing either 'MLR' or 'ERSP' and press enter. If you do not know what to choose just press enter

3.1.2 Start the interface for the calibration phase

Start up the interface script to run the calibration phase and collect the data.

1. You need to run the interface script in another Matlab window.
   You can open a second Matlab window by either double clicking, click with the middle mouse button, or holding shift while clicking the Matlab icon, dependent on your computer system.

2. In Matlab, navigate to the folder *BCI*.

3. Open *Calibration.m* by double clicking it.

4. Run the script.
   This will start up the calibration phase by opening a new window. In this window you will receive all instructions to finish the calibration phase

3.2 Feedback

After the calibration phase, the system is ready to be used. To use the BCI system, you again need to run two Matlab scripts in parallel.

- If you closed Matlab, you can restart two new Matlab windows by either double clicking, clicking with the middle mousee button, or hold shift while clicking the Matlab icon depending on the computer system you are working on.

- If you still have Matlab open from the calibration phase you can use these windows.

3.2.1 Choice prediction

To be able to predict to which target your subject is paying attention you need to analyse the data based on the classifier you created before.

- Run the script *FeedbackSsvepSigProFinal.m* in one of the matlab windows.

3.2.2 Feedback interface

The feedback need to be started up in another window to be able to give real-time feedback. This is done by analyzing the data while running the interface.

- Run the script *FeedbackInterface.m* in the other Matlab window.

- You can now use the BCI.

4 Trouble Shooting

In this section you can find some of the most common errors that could occur while using the BCI system.

1. Error message: *Wrong folder.*
   If you receive this error message you are not in the correct folder in Matab. Navigate to the BCI folder and run the script again.

2. Error message: *Cannot connect to local Host.*
   You get this error if you saved the BCI folder in the wrong location. Place the BCI folder inside the main folder of the bufferBCI.

3. While starting the interface you can get the error message: *PTB-ERROR: Mismatch between requested display swap interval 1 and actual swap interval 0! Synchronization of Screen('Flip') to display refresh will likely malfunction!*
   Psychtoolbox is an extension for Matlab which randomly gives this error sometimes. The only thing you can do is run the script again (sometimes you need to do this a few times in a row before it works again).