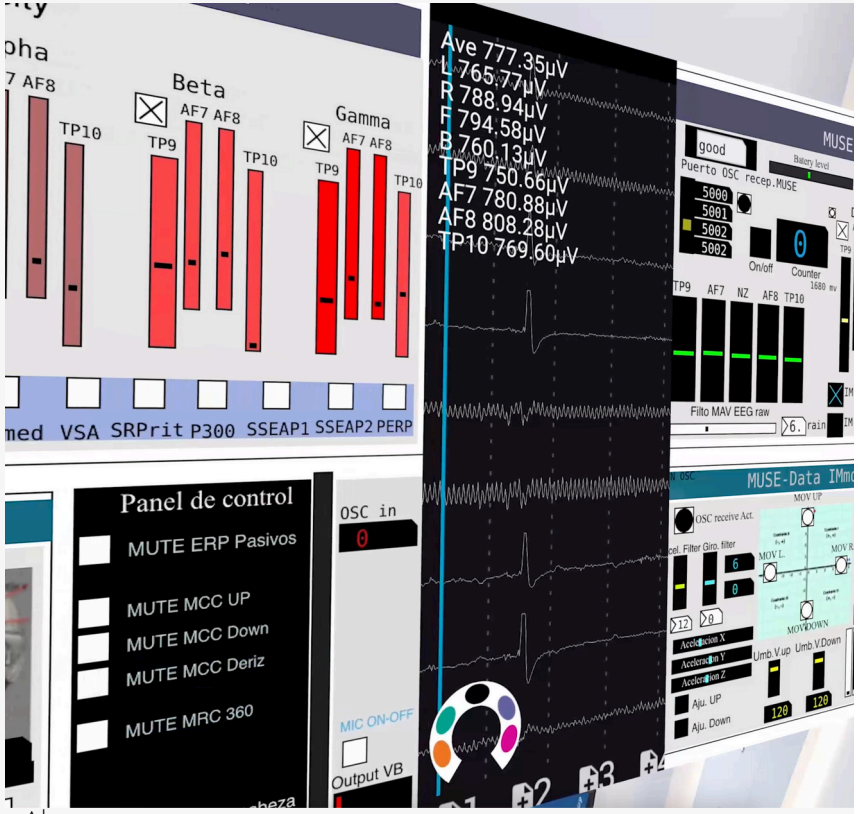
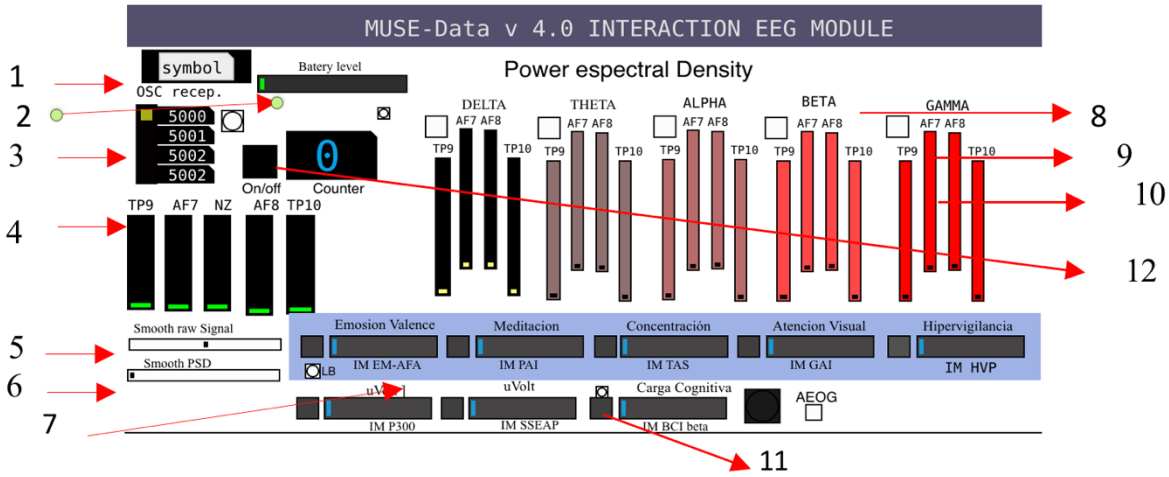
Patch Pure DAta

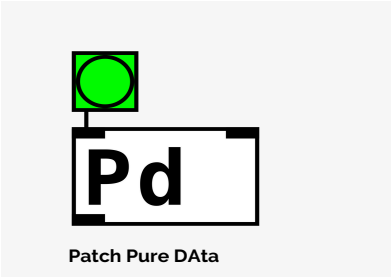
MUSE DATA V 4.0
MODULE

Diseño y desarrollo de sistemas MMHCI híbridos con bioseñales y un DMI de smartphones, para obras bio-interactivas mixtas y performáticas



Pure Data Patches for the PhD Thesis: Juan Pablo posada Alvarez





A general guide to the functions of the test module and connections in PD for the latest version presented in this doctoral thesis is detailed below.

1. Signal quality information on all electrodes:

   Low: Receiving good signal only on two of the 4 electrodes.

   Medium: Receiving good signal (3 of the 4 Electrodes).

   Good: Receiving good signal on all electrodes (ideal conditions for IM interaction.)
2. Device Battery Level
3. **OSC port**: This module allows the selection of the data reception port using the standard **OSC** protocol used for real-time signal transmission. Available ports (5000, 5001, 5002, and 5003) offer flexibility in configuring data streams, making it easy to integrate with multiple external devices or applications.

4. **Raw EEG**: Area dedicated to the graphical representation of the brain's electrical activity (in millivolts) captured by the four electrodes of the Muse 2 or Athena device. Amplitude variations are visualized in real time, allowing:
    - Monitor the stability of signals.
    - Detect artifacts or noise during calibration.
    - Adjust sensitivity filters using intuitive reference bars.
5. **Window Adjustment (Moving Average Filter) Raw Signal:** The adjustment of the filter window, specifically the moving average filter, allows you to modify parameters that directly influence the flow of the signal, optimizing the management of the noise present in the data. Low values in the filter configuration allow for a complete flow of the signal, including high-frequency noise components. Conversely, high values increase signal stability by reducing noise, although this can introduce an increase in system latency. It is important to consider that there is a trade-off between the noise suppression level and the response time of the device, which must be calibrated according to the requirements of the experiment.
6. **Window Adjustment (Moving Average Filter) PSD Values:** Adjusting the filter window, specifically the Moving Average filter, allows you to modify parameters that directly influence the flow of PSD values. S should adjust this value only in cases where the values have rapid and abrupt variations, in most cases a value of 4 adjusts the signal values appropriately.
7. EEG Interaction Section:

This interface presents the approximate values of each IM designed for the EEG interaction module using a set of visual *sliders*. Each descriptor is associated with a specific neurophysiological parameter, as detailed below:

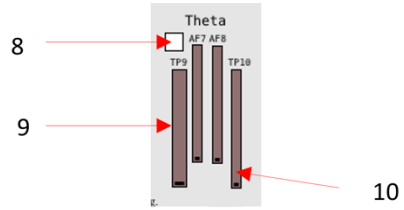
- Emotional *Valence*: This slider provides a visual guide to the performer's estimated emotional valence (positive or negative). A shift to the left indicates values associated with a negative valence, while a shift to the right indicates a positive valence.

- Meditation: This indicator reflects changes in the performer's states of calm or meditation. When the *slider* is positioned to the left, states of low meditation are detected, tending to a state of alertness or active attention. On the contrary, a shift to the right indicates high values associated with states of meditative calm.
- Concentration: This *slider* monitors changes in the performer's concentration states. Low concentration states are represented by the control shifted to the left. As the interpreter reaches greater states of attentional focus, the indicator shifts proportionally to the right.
- Visual *Attention*: This control represents the level of visual attention evoked detected. The more the *slider* scrolls to the right, the higher the level of visual attention recorded by the system.
- Hypervigilance: This indicator shows states of heightened alertness or hypervigilance induced or captured through electro-oculography (EOG) devices. The shift of the *slider* to the right corresponds to an increase in the detection of these states.
- Cognitive Load: This visualizer quantifies the estimated cognitive load level by analyzing electrode signals in frontal and temporoparietal regions. A position of the *slider* on the left indicates a low cognitive load, while a position on the right indicates a high load. Generally, this parameter exhibits an inverse correlation with the meditation indicator.
- P300 and SSEVP**:** This control is not operational In the current version with MUSE Athena or Muse, until revision 5.0
- EOG (Artifacts): This visualizer monitors activation based on predefined thresholds to detect EOG artifacts generated by voluntary blinking.

Each of the sliders has an on/off button, which allows you to control the sending of its corresponding values via the MIDI protocol. This functionality is essential to ensure the quality of the data prior to its processing.

8. PSD Stock Section

Single band section



On/Off (Brain Rhythm Bands**):** This button, integrated into each brain rhythm band (alpha, delta, beta, gamma), controls the activation or deactivation of data reception using the OSC protocol from the Mind Monitor application. When disabled, system and PMSon interactions are temporarily suspended. This option allows the user to selectively manage the display of bands of interest.

2. TP9 Slider: This graphic component available for each brain rhythm band, displays:
    - The power spectral density (PSD) activity recorded by the TP9 electrode.
    - The average PSD value for the selected band, calculated from all electrodes.

   Technical note: To ensure the correct display of the average, it is necessary to previously enable the option to send averaged data in Mind Monitor.
3. AF7, AF8, and TP10 Slider: Analogous interface to the *TP9 Slider*, designed to visualize the PSD activity of the AF7, AF8, and TP10 electrodes in each brain rhythm band. These elements facilitate the comparative monitoring of neural activity
4. Base Adjustment: This button allows you to adjust base values for cognitive load. This option is useful when the performer's values are outside of the normal parameters

5. ON/off:

It works as a switch for the 60-second timer used in Multimodal Interfaces (IM) tests with ERP. Its activation initiates the countdown, synchronizing the measurements with the experimental stimuli

Caunter: A component of the graphical interface that shows the time remaining in IM tests. It operates at a fixed interval of 60 seconds, ensuring temporal accuracy and replicability in sessions. This tool is critical for standardizing the duration of trials and validating the synchronization between stimuli and neural responses

The module is connected as follows:

Outlet 1: Connection to the MUSEDataIMmov module. If this connection is not established, the functions associated with:

- Motion detection.
- PPG and fNIRS sensors

Outlet 2: Binary output (**1/0**) for event-related potentials (*EOGs*) events