**LEARNING ABOUT BIOSENSORS AND ELECTRODES**

**Ref:** [**https://www.mdpi.com/1424-8220/20/21/6233**](https://www.mdpi.com/1424-8220/20/21/6233)

**DURABILITY**

**Washing electrodes**

* **10 cycles in a domestic washing machine**
  + **4 g/L non ionic detergent at 40 C for 30 min according to the** ISO 105-C06-A1S, 2010
  + **Dried at room temperature**
  + **Each cycle, same procedure**

**Stretching and conductivity**

* **Resistance was measured before and after stretching them a 30 percent of its original length**

**Electrical properties**

* **As the resistance becomes lower the ability to collect signals and its stability becomes better**
* **Independent t tests where done to test if there were statistical differences between textiles**

**Acquired signal using textile electrodes**

* **Need to check on the pressure that we are applying to the skin (this modifies the conductivity)**
* **SNR**

**Use cases**

* **Subjects in motion and subjects still**

[**https://iopscience.iop.org/article/10.1088/1757-899X/1266/1/012019/pdf**](https://iopscience.iop.org/article/10.1088/1757-899X/1266/1/012019/pdf) **( only 2 citations)**

* **Washable up to 100 cycles electro conductive silver plated polyamide obtained from Adafruit, 1.4 Ohm/sq**
* **2 cm diameter circular EEG electrode**
* **Fabric on foam to ensure the fabric is pressed against the skin**
* **Data collection with OPEN BCI**
  + **5 min of static eeg measurements**
  + **SNR**

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AI-generated content may be incorrect.**

* **Skin to electrode impedance**
  + **F ratio and p value, one way anova**
  + **Average resistenance 2.5kohm**
  + **The impedance of the tissue drops with time which could be done to sweat generation**
  + **( plotting over time the evolution of resistance for different electrodes, in a specific bandwidth)**
  + **A graph of a graph

    AI-generated content may be incorrect.**
* **1-50 Hz bandpass, amplitude of 0,1 uV to 1 mV**
* **FFT plot, amplitude at each freq and ten seconds average Vrms amplitude ( for both electrodes)**
* **Plot of both SNR**

**REF**

[**https://www.mdpi.com/1424-8220/23/2/598**](https://www.mdpi.com/1424-8220/23/2/598) **( 10 cites)**

* **Transfer function and cost function to validate the performance of the different electrodes**

**REF** [**https://jtatm.textiles.ncsu.edu/index.php/JTATM/article/view/4196/2842**](https://jtatm.textiles.ncsu.edu/index.php/JTATM/article/view/4196/2842)

* **Fabrication of textile electrodes**
  + **Foam between two layers of conductive fabric to ensure the pressure against the skin**
  + **A non-conductive fabric, made of cotton, with a centered holewith diameter of 2 cmon the front side has been placed above the conductive fabric to make the conductive surface of the electrode in contact with the skin of similar size as the surface of the commercial silver electrodes**

**REF**

[**https://www.mdpi.com/1424-8220/22/20/7869**](https://www.mdpi.com/1424-8220/22/20/7869)

**Metrics**

Dehydration test; then their impedance, signal quality, and stability

**REF**

[**https://journals.sagepub.com/doi/10.1177/20556683211061995**](https://journals.sagepub.com/doi/10.1177/20556683211061995)

**17 JULY**

**SENSORS OF EARBUDS EEG**

**NAOX REF**

[**https://www.mdpi.com/1424-8220/24/12/3973#table\_body\_display\_sensors-24-03973-t001**](https://www.mdpi.com/1424-8220/24/12/3973#table_body_display_sensors-24-03973-t001)

|  |  |
| --- | --- |
| Skin Contact Location | Ear canal |
| Electrodes | 2 actives and dry silver electrodes by ear tip |
| Channel | 1 single bipolar EEG channel left ear–right ear |
| Sampling Frequency | 250 Hz |
| Transfer of Data | Bluetooth 2.4 GHz |
| Data Format | The European Data Format (EDF) |
| Autonomy | ~10 h |
|  |  |
| Weight | 20 g |
| Input noise | <6 μV peak to valley |
| CMRR | >80 dB at 50 Hz |

* **Silicon and coatd with conductive silver ink, biocompatible and conductive**
* **The system operates a single bipolar EEG channel, measuring the voltage differences between the electrode located in one ear canal and the electrode in the opposite ear canal**
* **Compared to temporal electrodes T7 and T8**
* **The GND is connected by linking the bottom electrodes of each earpiece ELI and ERI inside each both ear canal**
* **250 hz and 24 bits resolution**
* **BLE to a laptop**
* **10h recording**

**TEST**

* **Linear correlation during eyes closed condition for the alpha band. TO do that Gabor wavelet was used**
* **Windows of 6s**
* **Defined an alpha burst by considering a signal-to-noise ratio**
* **Characterization of alpha burst recorded by the in ear device, amplitude analysis on windows. Averaged Hilbert envelops of the filtered signal in 30s windows for alpha, additionally comparision of the psd.**
* **Computation of artifact amplitude for the eeg cap an earbuds, comparing during horizontal eye movements**
* **Comparison of evolution**

**Mentalista**

**REF**[**https://mentalista.com/rosette**](https://mentalista.com/rosette)

* **Mental core: Arm Cortex M33 128 MHz nrF5340 1 Mb flash 512kb low leak**
* **Size 52mm x 29.5 mm**
* **ADC:**
  + **1 channel low noise**
  + **24 bits resolution**
  + **125 sps to 8 kbps**
* **Crypto** 
  + **Arm Trustzone Cryptocell 312**
  + **128 bit AES**
* **370 mA battery 250 Hz 33 h**
* **Power consumption 115 mW**