NeuroDevices 101

Hector Orozco & Saurabh Shaw

NeuroTech 101

Monthly workshops during the next 6 months that end with a Hackathon

This year:

- NeuroDevices 101 (TODAY)
- Neuroscience 101 (18/October/2017)
- Digital Signal Processing & Feature Extraction I (15/November/2017)

All resources will be available on GitHub!

NeuroDevices 101: Objectives

1. Specs of each headset

2. Getting raw data and storing it for offline analysis

3. Getting a live stream of raw data
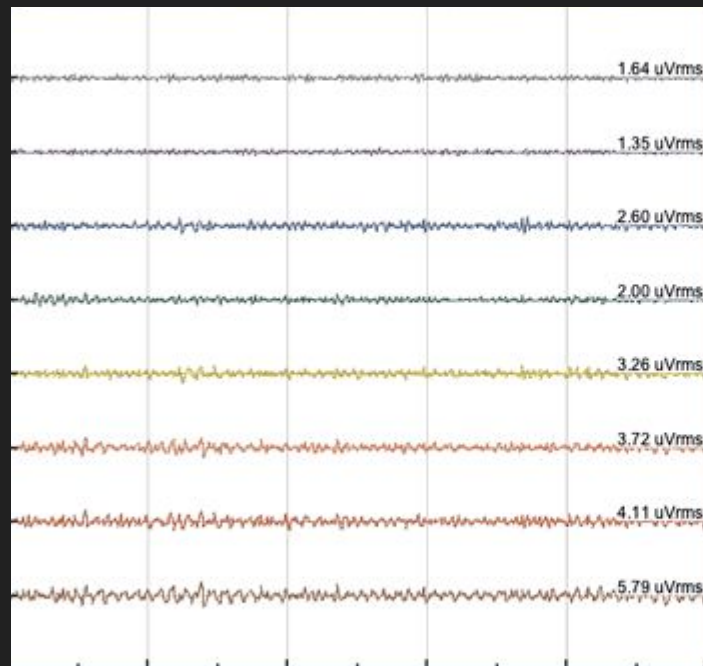
NeuroDevices 101: Roadmap

1. Consumer EEG headsets and their characteristics
2. Special guest: Aurora Dreamband (James Collura, iWinks)
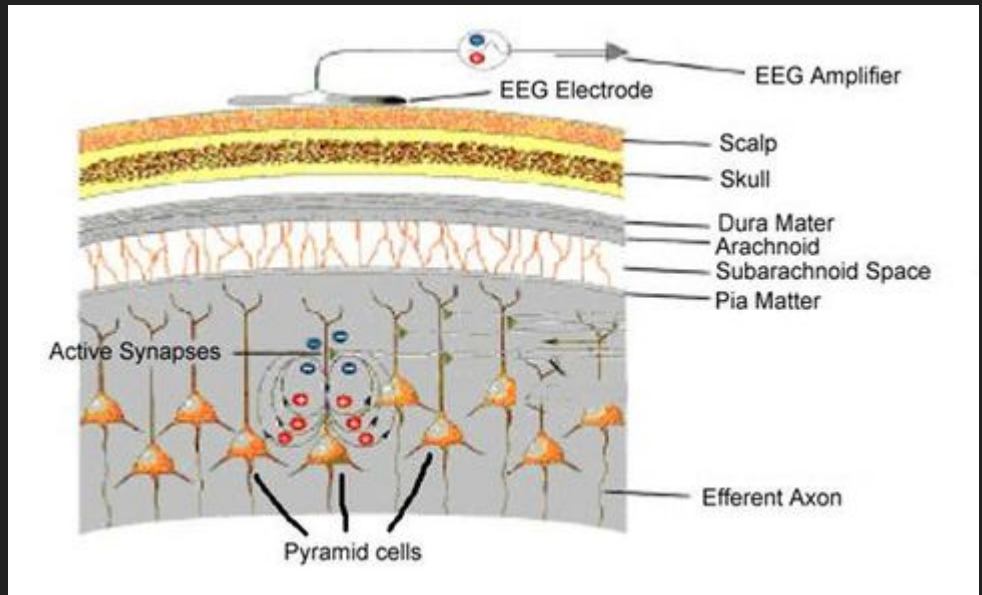3. Gettins the data out of the headsets (in the most free and legal way possible)

Quick intro: EEG

Underlying neural activity from neural cortex
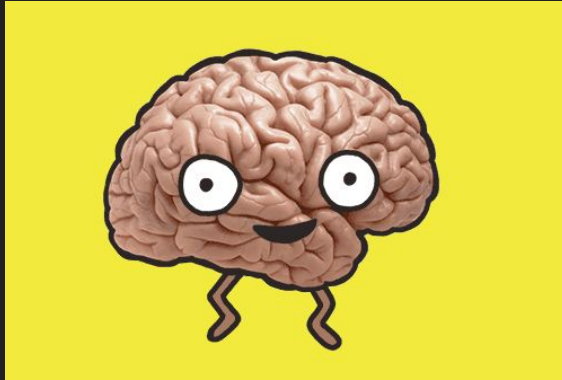
Volume conduction

Electrode coverage

External noise

Which headset is the best?

It depends!

Features to take into consideration...

Number & placement of electrodes

Electrode type

Sampling rate

ADC bits (or the resolution of the signal)

Cost

The objectives of your project!

The headsets

NeuroSky's Mindwave

Uses AAA Battery - 8 hours

1 Channel + 1 Reference

Outputs NeuroSky proprietary eSense
meter such as Attention, Meditation,
and other future meters

12 bit ADC

Interaxon's Muse (2016)

Muse: the brain sensing headband, is an electroencephalography (EEG) technology. Probably the easiest to get started with!

Wireless (bluetooth), lightweight, flexible, adjustable, easily worn

Two channels on left and two on right

One auxiliary micro-USB ports (auxiliary electrode)

Includes a 3 axis accelerometer

Muse: Features

Static, dry electrodes (frontal: silver; temporal: conductive silicone-rubber)
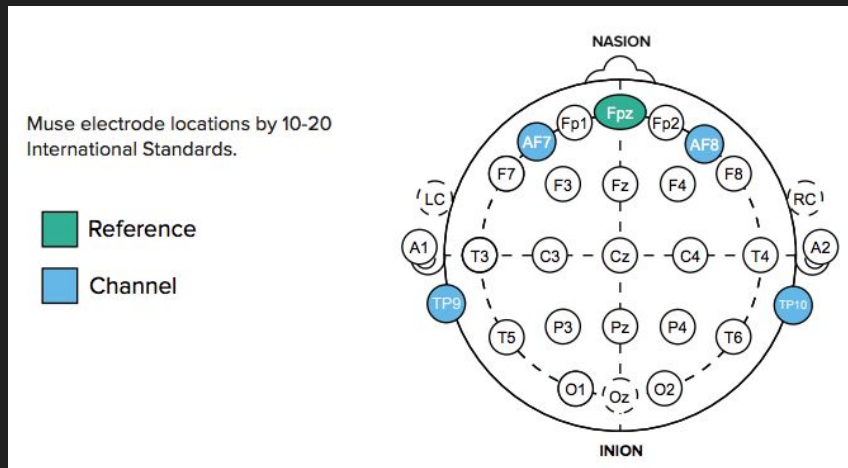
256 Hz Sampling rate

12 bits/sample

Research Tools for Windows, Mac and Linux
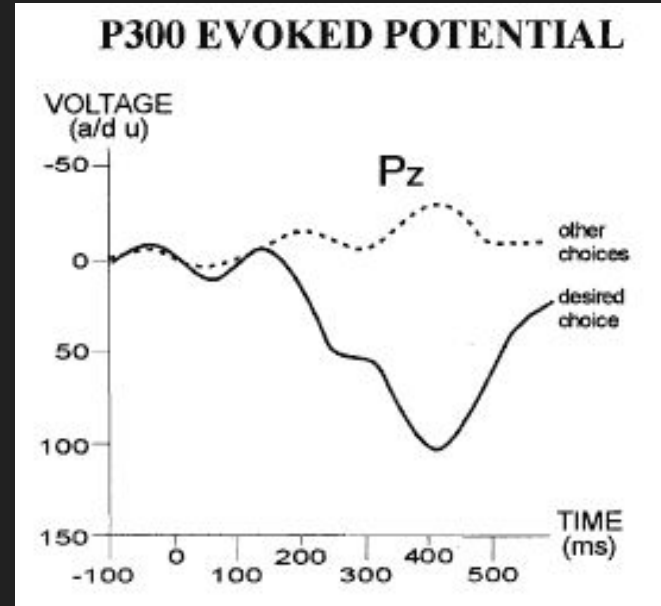
SDK for Android, IOS, Windows

Price: $299.00CAD

Known Recordable EEG Paradigms

Relaxation level

Concentration level

Frontal asymmetry

P300

P300 EVOKED POTENTIAL
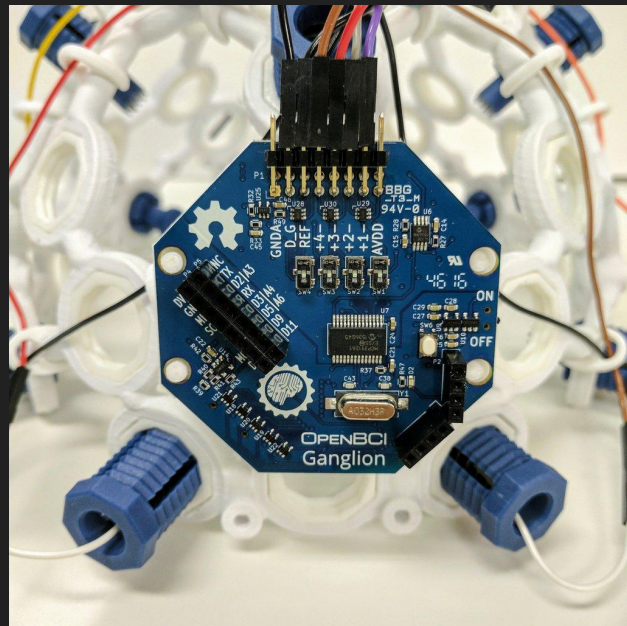
OpenBCI's Ganglion Board

Open Source Brain-Computer Interfaces

The OpenBCI Ganglion is a high-quality, affordable bio-sensing device.

4 high-impedance differential inputs

The most versatile; but you need to know what you are doing!

Can 3D print the headset (3D axis accelerometer)

Ganglion Features

Flexible wet/dry electrode placement

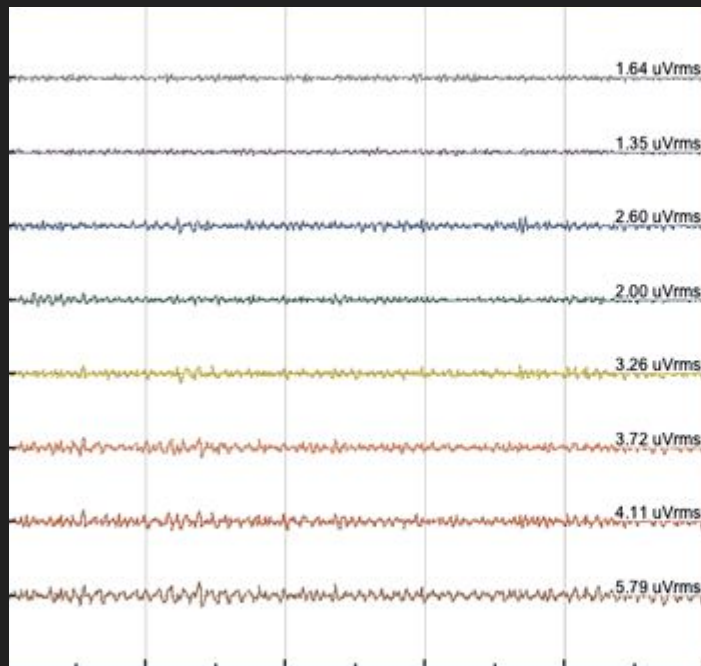256 Hz Sampling rate (~13k with Wi-Fi shield)

24 bits/sample

Open Source Software and Hardware

$250.00 CAD (Does not include electrodes!)
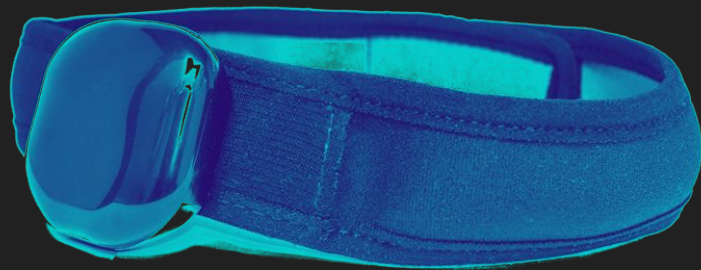
Known Recordable EEG Paradigms

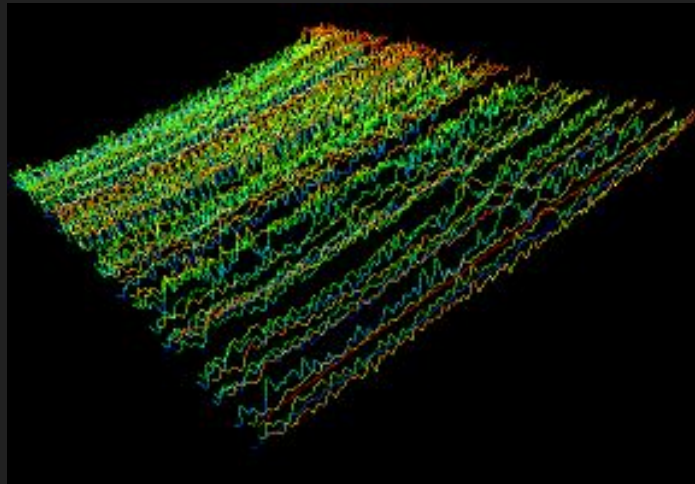If you know what you are doing, pretty much any EEG paradigm can be done!

Compare and contrast!

Device	Channels	ADC Bits	Sample Rate	Motion sensors	LSL Support	Cost (CAD)
Muse 2016	4-6	12	256 Hz	3 axis	Yes	$299.00CAD
OpenBCI Ganglion	Up to 4 channels (+)	24	250 Hz (+)	3 axis	Yes	$250.00 CAD
Neurosky Mindwave	1+1 ref	12	512Hz	N/A	N/A	$99.99

The intermission

The methods

Lab Stream Layer (LSL)

Open source protocol for unified collection for measurement time series in research experiments (multi-platform, multi-language)

It handles…
- Networking
- Time-synchronization
- (near-) real-time data access
- Centralized data collection
- Data visualization
- Data disk recording

NeuroSky

Option 1: MuLES (https://github.com/MuSAELab/MuLES)
- Only available for Windows
- Can use multiple protocols to stream data

Option 2: LabView Module (Download Link)
- Need LabView (Paid)
- Can quickly prototype BCIs

Option 3: Fieldtrip Toolbox (http://www.fieldtriptoolbox.org/)
- Need Matlab (Paid)
- Opensource toolbox - very feature rich

Muse

Option 1: Muse-lsl
(https://github.com/alexandrebarachant/muse-lsl)
● Use LSL to stream data OR save it as a CSV
● Only compatible with Muse 2016

Option 2: MuLES (https://github.com/MuSAELab/MuLES)
● Only available for Windows
● Can use multiple protocols to stream data

Option 3: Muse Lab
(http://developer.choosemuse.com/research-tools/musela
b)
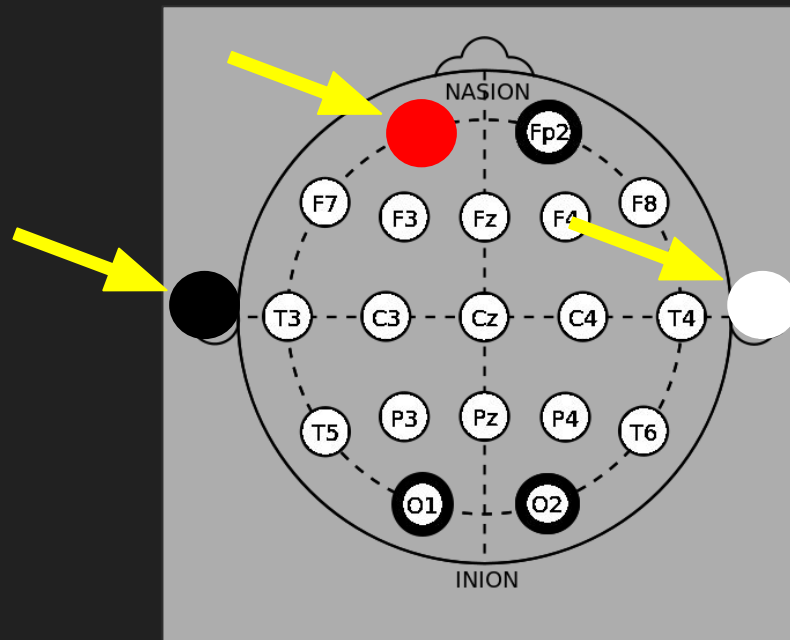As of Sept 2017, only compatible with Muse 2014

OpenBCI - The setup

First, the setup
- Red: Electrode (Pin 1, Top)
- White: Reference (Ref, bottom)
- Black: Ground (D_G, bottom)

We can use the OpenBCI_GUI to stream data, but you need to run it from Processing!

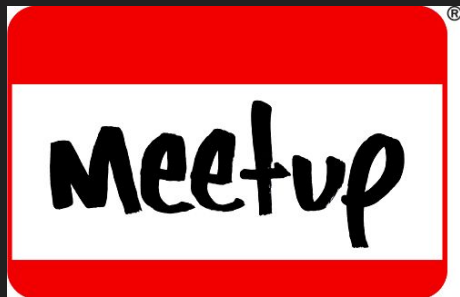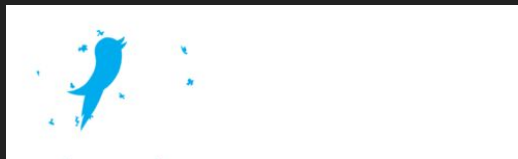OpenBCI-LSL (https://github.com/OpenBCI/OpenBCI_LSL)

NeuroTechHa - Join the conversation!

NeuroTechX's Slack, _hamilton channel

Twitter: @NeuroTechHa

Meetup: NeuroTechHa

Facebook: NeuroTechHa

Questions/Feedback?

Watch out for our email with information regarding the informal hacknights!

Thanks!